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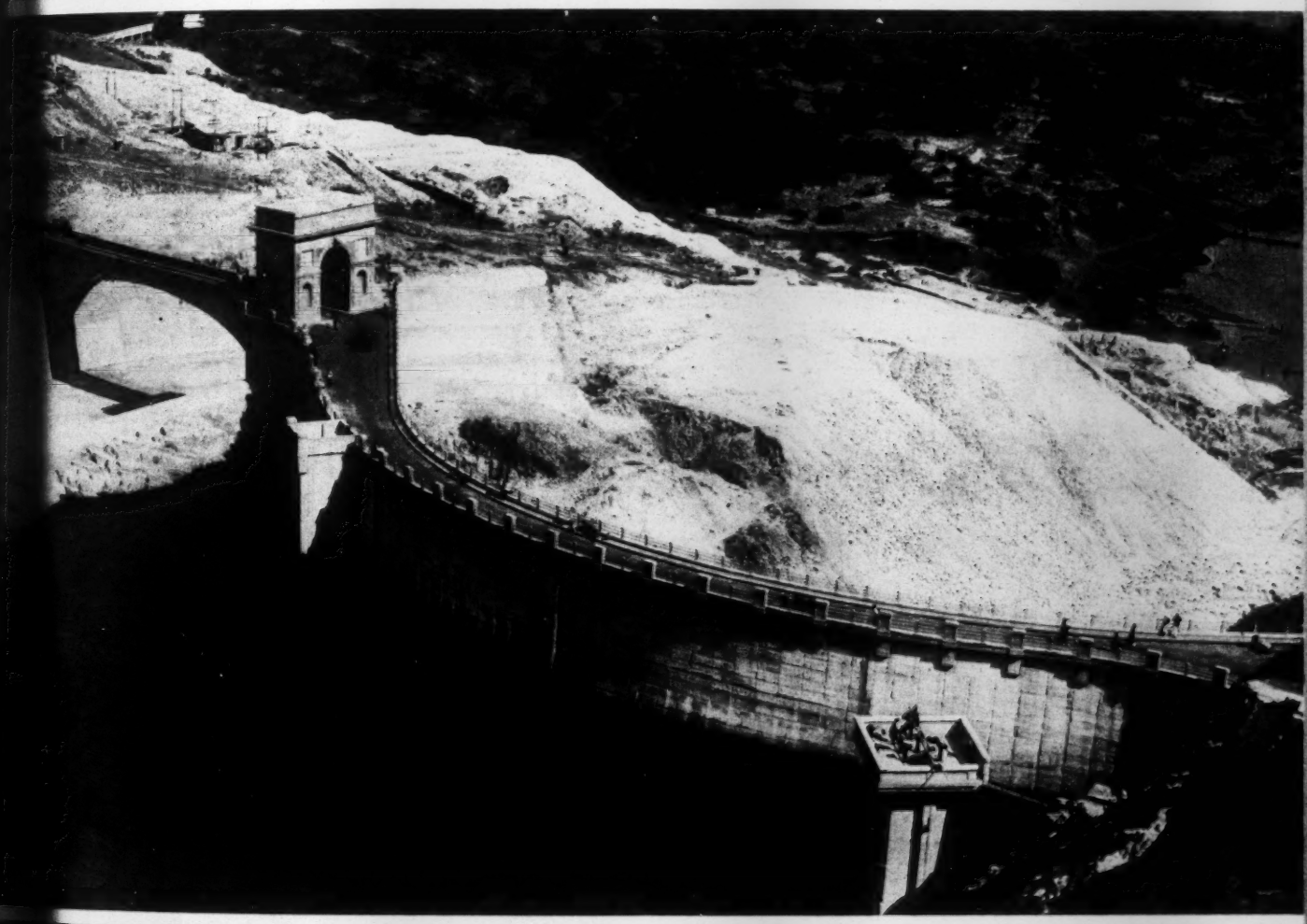

Architectural Treatment in Foreign Dam Construction, Hartebeestpoort, South Africa

Type of Turntable Developed for Heavy Locomotives

Standard Detour Marking System on Ohio Roads

Hartebeestpoort Irrigation Dam in South Africa

An Economic Study of Dragline Excavator Operation: 2

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 92 NEW YORK, JUNE 5, 1924 Number 23

A Necessary Preliminary

TWO prominent engineers this week announce their candidacy for high political office. Dean Cooley is going to run for Senator from Michigan and Mr. Hirst for Governor of Wisconsin. For the present their contests are only for the nomination and will be decided in the September primaries, so that no partisan politics enter into them. It is quite proper, therefore, for a non-partisan technical journal to wish them both the best of luck and to congratulate them on the decision to offer themselves for public and political life. Engineers as a group can do something to improve political conditions, but politics, after all, is largely a personal affair—from the lowliest voter to the President himself—so the engineering influence on the conduct of public affairs is going to make itself felt most through the engineers who get elected to office. Dean Cooley and Mr. Hirst have done more than merely to talk about engineering uplift; they have taken the first and necessary step to make such uplift effective.

An Opinion on Licensing

IT IS refreshing to have one of the Nestors of the profession come out against engineering license laws; refreshing because any discussion of an active movement is interesting and helpful. Mr. Herschel's letter of comment (p. 988) on the report of the Joint Committee on Structural Safety is sure to be helpful, even though it represents dissent. Whether the dissent is from the principle of limiting the right to the use of the term "engineer" or from the present method of applying it is not wholly clear. This point would have been cleared up if the letter had suggested a way in which the recognized objects of licensing may be attained by other means. It is instructive to recall that while license laws have been enacted on the demand of the profession itself, they are intended for the protection of the public, not for the protection of the engineer. In the long run they will have to stand or fall according as they do or do not protect the public. But we believe that no final judgment can be passed on them in their present form. License laws are still quite primitive and no doubt they will have to go through an extensive evolutionary process before they are satisfactory. Their present imperfections are matters that still require much critical study. Mr. Herschel refers to the tendency of present license laws to confine engineering practice within state boundaries, a difficulty which in many states has been taken care of by reciprocity provisions. If such provisions prove to be insufficient to overcome the confining tendency, other means will have to be found. Another difficulty lies in the fact that engineers of all kinds and creeds are licensed under the same terms, whereas the committee on structural safety apparently desired to single out structural engineers as the one kind competent to direct building operations. It may well be that differentiation of engineers will turn out to be an important desideratum, and in that event license laws will have to be revised further. Experience is required for developing all such points of improvement, and discussion and criticism are of value in clarifying that experience.

The Philadelphia Water Plan

A MASTERLY plan to meet the present and future water-supply needs of Philadelphia is now before the officials and people of that city. Its early adoption and execution would give Philadelphia a supply far superior to the present one in quality, pressure, quantity and dependability. The plan now recommended by a joint committee of city and consulting engineers is an expansion, with some changes, of one recommended in 1920. Indeed, some of its leading features have been advocated for decades as advantageous parts of a new water supply for Philadelphia. Interest in the proposed plan has been heightened by opposition to it promptly voiced by a retired chief of the Bureau of Water who during his recent short incumbency proposed the earliest possible abandonment of both the Schuylkill and Delaware intakes now in use, instead of abandonment of the Schuylkill alone, as is proposed by the engineering commission whose report is presented nearly in full elsewhere in this issue.

Legal Standards and Professional Ideals

RARELY does a technical society elicit a more timely and widely applicable paper than the one on Professional Standards and Government Requirements by Prof. George C. Whipple. Although read before the American Water Works Association and very appropriate at the time and place because the new Treasury water standards were up for discussion, Professor Whipple's paper would, except for a few sentences here and there, be just as appropriate if read before any other technical society. In well reasoned words the author urged ideals of professional excellence rather than governmental standards designed to have the force of law. Further than this we will not go in outlining the scope of the paper, which was abstracted at some length in our issue of May 29, p. 924, and which some of our readers might have overlooked because it was printed with other abstracts of papers read before the association named. One timely matter of practical application may be mentioned. Professor Whipple suggested that the Treasury Department (U. S. Public Health Service) should not go too far in establishing high standards for drinking water, even though it be claimed that the standards are designed to set ideals rather than to be compulsory in all respects. The federal government, as Professor Whipple well said, may rightly prohibit the supply of dangerous water for drinking on interstate trains and boats but might well consider leaving standards of excellence to the waterworks and health associations.

Concrete Pavement Wear

PRACTICE has come gradually to discount wear as a destructive agent in concrete road operation. With materials and proportions capable of producing a sound, strong concrete and a slab structure which would stand up under load it has been assumed that wear would be adequately taken care of. It appears now that while this practical conclusion concerning wear has been based alone on judgment and observation, it is confirmed in general by wear tests conducted on an elaborate scale and closely controlled and observed. The results of these tests, which were made by the Bureau of Public Roads, are summarized in this issue. There are a score of conclusions reached by the government experts but the broad conclusion that the practicing road engineer may reasonably draw is that if he continues to use present proportions with an aggregate containing no material that is distinctly soft or friable and continues to build a pavement that will stand up structurally he need not be concerned particularly about its endurance against surface wear if the width-distribution of traffic is ordinarily uniform. Indeed the wear hazard today on any hard-surfaced road is confined virtually to occasions when snow ruts are formed and the vehicle tires, with chains, grind over two narrow ribbons of pavement for days and weeks. Obviously the control of this hazard is snow removal and not search for an adamantine paving material.

Detour Improvement

A NOTABLE improvement in the practice of marking detours has occurred even in two years. In five years the standard markers have changed beyond all resemblance to the cardboard placards nailed to a fence rail barricade and convenient trees or poles, which were common in 1919. Then, generally, the contractor had the task of marking detours and he did it about as he pleased so long as he satisfied the vague requirement "marked clearly" which was the substance of the official specification. On county and township roadwork one still meets with examples of these antique practices, but in state-road construction in the states where improvement is at all intensive the contractor does no detour marking or else does it under plans and specifications as precise and rigid as any that define his other activities. The construction of markers has advanced equally. The detour signs used in many states are not materially, if to any extent, inferior to the permanent-route signs. An excellent example is afforded by the practice in Ohio which is described in this issue. It is typical of the high perfection which detour marking has reached in leading road-building states. With good maintenance such marking goes about as far as can be gone to mitigate the curse of the highway detour.

The Economy of Speed

HYDRO-ELECTRIC developments being built to supply rapidly growing communities of the West have a twofold incentive to speed in construction: A shorter construction period means (1) a shorter time during which interest must be paid on non-producing investment and (2) a revenue from power (which would otherwise be lost) during the time by which the construction period can be shortened. For example, a certain hydro-electric project is to cost altogether about $14,000,000 and the construction period will be about two years. Assuming a uniform rate of increasing investment from zero at the start to fourteen million in two years, the average interest charge at 7 per cent is $2,684 per day. The gross revenue from power developed will be approximately $3,000 per day (figured as value of the power at the power house) from which 10 per cent may be deducted as operating cost (exclusive of interest) leaving a net power revenue of $2,700 per day. Thus if the power company carries on construction with its own forces the incentive to speed up the work is tantamount to a $5,384 per day bonus-and-penalty clause written into a construction contract. This is not a net gain to the power company, of course; the State Railroad Commission permits the company to earn 8 per cent on its investment and hence any reduction in first cost is primarily a saving to the consumer. However, regardless of how the accountant may credit the gain, to the engineer this constitutes an incentive for carefully watching construction progress throughout the various parts of the work so that special attention may be concentrated wherever the schedule is likely to be delayed.

Success or Failure

AN IMPORTANT question ought to find its answer next week at San Francisco. The coming convention of the American Association of Engineers should tell how the internal struggle that came to a crisis at the Norfolk convention, last May, was decided. At that time the professional-unity movement which the association represents was in dire peril of shipwreck. The selfish phase and the altruistic phase of the movement had come to grips, and it seemed as though mutual destruction might be the outcome. No one could be clear as to whether the organization existed to serve the self-interest of the individual member, or whether it existed to serve the community at large. Partisanship engendered narrowness of view—as always—and few remained cool enough to see that there was work to be done and that quarreling thwarted all useful effort.

How threatening the situation appeared to a bystander was set forth by us in an editorial of May 17, 1923. Now we hope to learn that the strife is over and the organization is realigned for progress and performance. During the quiet of the year little more could be noticed than that the association still existed. Within the past few days one or two preliminary pointers have appeared in the program of the convention and associated data. It appears that the association has been managed with financial wisdom, in spite of low income and large expense; that some of the worst mischief-makers have left; that its constructive activities have been continued without diminution; and that decrease of membership has been checked and changed to growth, with a present roll of some ten thousand practising and five thousand student members. These are decidedly hopeful items of testimony, the more hopeful because they relate to a period during which other co-operative movements among engineers have declined, notably the Federated Societies. But the full answer is yet to be awaited. Whether the association has really been saved and is moving toward a healthy and useful future remains to be shown by the convention itself. Until such a result is shown, this adventure into non-technical co-operation of engineers for mutual aid and public service is a doubtful experiment.

To An Embryo Engineer

BY THE time this reaches you, if you have been moderately diligent, you will have lettered your last map, submitted your last report, and passed your last examination—as an undergraduate. For the next few weeks it should be permitted you to loaf and invite your soul, with occasional interludes in the way of inescapable advice—baccalaureal, valedictorial, professorial and parental—as to how best you should profit by the strenuous four years you are completing. To receive advice respectfully is expected of youth, though age knows too well, from both experience and observation, that such respect is merely the deference due to seniority and not a pledge of performance. However platitudinous the advice you receive appears to be you will, therefore, listen to it with becoming gravity if for no other reason than that, a few years hence, you will expect a like demeanor on the part of those who will listen to you.

In these few weeks which, in all propriety, can be spent under familiar trees and with unburdened mind, you should find time to consider, from a closer viewpoint than you have had before, the prospects of your next few years. For you are about to become an engineer, and to become an engineer after four years of conscious academic training to that end involves certain difficulties and imposes certain obligations.

Be under no illusions as to the part your collegiate training will play in these first years as an engineer. For fifty years or more the technique of engineering education has been in process of development. What you have been receiving is therefore the result of thought and trial and experiment and it is the best system of instruction that the collective intelligence of pedagogues and practitioners has been able to evolve. It is, indeed, much better than your superiors will make it out to be. For you will find, when you emerge from the academic halls, that it is the fashion nowadays among engineers to decry the details of engineering education. You will find, in fact, that the concern as to the nature of that education has gone so far as to lead one of our benevolent scientific foundations to appropriate a very considerable sum of money with which a thorough study is to be made of the way you have been taught, and the things you have been taught and the effect of that way and those things on your prospective position in the world.

But you would do well not to be too discouraged at this manifestation. Man is an incorrigible optimist. He thinks that things can always be done better than they are being done and he spares no effort to bring about such improvement. Further than that he has difficulty in relating himself as a veteran to himself as a recruit. He readily forgets how little he once knew and how hard was the road to knowledge. He is forever searching for some catchword, some method, some system that will serve as a hotbed for experience. Much of the engineer's attitude toward professional education is thus explained. He would save his successor the travail of experience; he wants somehow to design a course of instruction which will produce an engineer and not merely an embryo engineer such as he was and you now are.

And so you will find that the superiors who employ you will be apt to be overcritical; that they will expect you, or at least make out that they expect you, to know things that by no possible chance you could learn at school and which they themselves learned only after years of personal trial and error and when they find you lacking they will not only rail at you but at the system of education of which you are a product.

You will be armed against such criticism if you remember what your superiors are prone to forget, that school training is not a substitute for experience but merely a preparation for it. What you have been studying is not overly important in itself; it will have value only as you apply it. A sufficient realization of this will keep you from a common pitfall of the embryo engineer—that is the worship of the taught method or the recorded data, of all the material information you have gained from other men, which you will find is termed "theoretical," as distinguished from that which you learn yourself, which is commonly called "practical." Do not, therefore, thrust forward too much what you have been taught, but keep it discreetly submerged, the foundation on which to build the practical knowledge you will slowly accumulate. By so doing you will alike serve your own future to good advantage and avoid the common charge of excessive self-regard.

For you should know that the young graduate is popularly credited with undue appreciation of his own capabilities and knowledge. This, too, is contrary to the average man's recollection of his own early state of mind but most men, once past the post-graduate period, are willing to believe it of the rising generation. Your only defense against this unwarranted belief is a militant expression of the modesty you really possess. You need not carry this modesty to the degree of humility, for the promised inheritance of the earth by the meek has as yet not been realized. But remember that you are traditionally supposed to be overly sure of yourself and govern your words and actions to dispel such an impression. The burden of proof lies on you.

If you have successfully completed a full course in engineering you have prepared yourself as well as anyone now knows how for the slow business of becoming an engineer. Let no one by argument or insinuation persuade you to the contrary. Your procedure has the warranty of success; the large body of successful engineers who have followed it bear witness to that. But, do not allow yourself to believe that by starting along the right road you have already reached your destination. There are numerous bumps and curves ahead which the excellent road map you have been studying the past four years did not chart. And you will find that it does little good to chart them, for they change too frequently. But be assured; the goal can be reached. It is well you should know, though, that it is peculiar, in that once there or near there you will inevitably conclude that there were better ways of reaching it than the one you, or your contemporaries, took and you will immediately set about, just as are now your seniors, trying to locate and to make smooth one of those new roads.

If you keep in mind that tendency of man, you will be able to accept with more philosophy and better appreciation the flood of advice which you are about to suffer—of which this, you doubtless will have noticed, is a part.

Types of Turntable Developed for Heavier Locomotives

Continuous and Two-Span Tables Replace Cantilever Type—Larger and Heavier Locomotives Introduce Problems Not Present With Light Power—Lower Maintenance Cost and Quicker Operation

CANTILEVER or tipping turntables have been used almost universally in the United States for turning locomotives from the earliest days of railway development. European practice has tended in other directions, preferring continuous or discontinuous (two-span) turntables. The center-bearing tipping table has the advantage of low resistance to turning, permitting hand operation even with fairly heavy locomotives; but this advantage has tended to disappear with the increase in engine weight and length—which now call for turntables 95 to 110 ft. long—and the extensive adoption of power tractors to turn the tables. Under these conditions the numerous disadvantages of the tipping turntable have made themselves felt more and more, with the result that in recent years there has been a steady drift toward the adoption of either continuous or two-span construction.

Two very carefully worked out designs have recently been put in service, a continuous table by the American Bridge Co. and a twin-span turntable by the Bethlehem Steel Co. They are both designed to overcome the disadvantages of the old type cantilever tables, namely, the large clearance between wheels and circle rail to permit the ends to swing free under full load, and the consequent hammering of the wheels and the circle rail at all points where locomotives move on and off the table, the delay due to the necessity of balancing each locomotive over the center of the table before it is turned, and the requirements for a stiff and consequently deep table to reduce deflection.

With the new tables no time is lost in balancing an engine, the table being swung as soon as all the engine wheels are on its deck. Thus for a given maximum engine wheelbase it is stated that the length of table may be 10 to 15 per cent less than that of a center-bearing table. In handling dead locomotives with a switch engine of small wheelbase, both engines may be placed on the table, thus avoiding delay.

Continuous Turntables—In the structure of the continuous table the girders are proportioned to give end reaction sufficient to develop ample traction under dead-load and prevent any lifting at the free end under one-sided loading. Lateral strength and stiffness are provided by systems of lower and upper laterals designed for the most unfavorable conditions (full load on one-half span and drive through the motor at the free end only) and are favored by the absence of joints and the continuity of the flanges of the main girders. The bracing system includes struts on the girders to the outer ends of the truck frames to hold the trucks in true position without diminishing their vertical flexibility.

Flexibility of the trucks to give equal division of load among the several wheels is provided by the use of two equalizers or truck frames, one centered under each of the two main girders. Only the reinforced girder webs bear on these frames, so that the truck frames can rock slightly in the direction of their length; sufficient play is provided under the nuts of the bolts which connect the main and truck girders to allow of this rocking. Railway car journal boxes of the M.C.B. type support the six undriven truck wheels, while the driven wheels, which may be subject to load reversal by the action of the driving gear, have a pedestal bearing. An extension of the truck frame carries an intermediate shaft and the motor, with double gear reduction to the driven truck wheel. The position of the driving machinery on this overhang

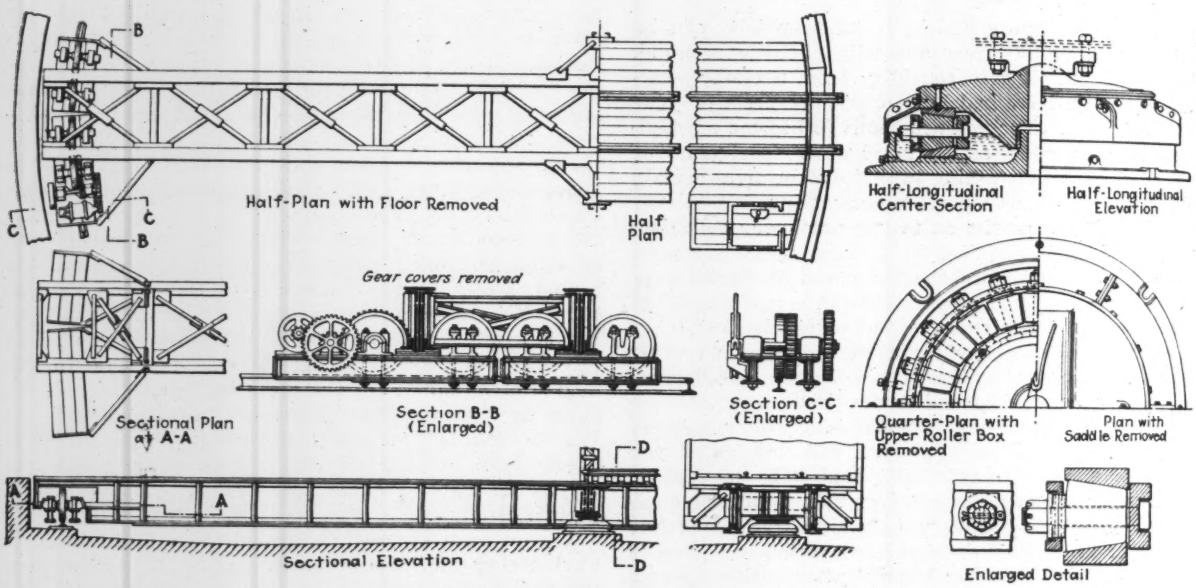


FIG. 1—DETAILS OF A CONTINUOUS TURNTABLE

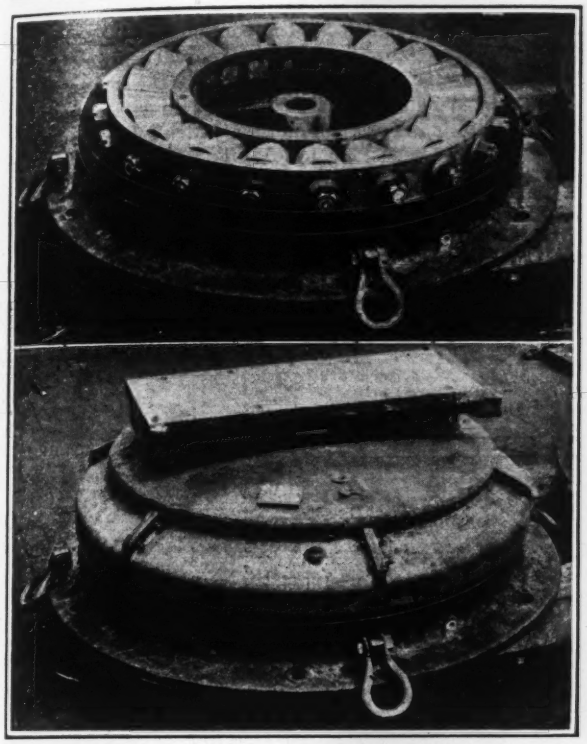


FIG. 2—CENTER BEARING FOR CONTINUOUS TABLE

gives increased adhesion to the driven wheel, which is an advantage when the table is empty.

The table has two driven wheels, at opposite corners, and correspondingly a motor drive on each truck. The two motors are coupled electrically but not mechanically. For usual conditions, induction motors with resistance control are provided. The brake, hand operated, is placed on the intermediate shaft, which position gives greater braking effect than a brake on the axle and avoids the extra load on the motor pinion which would be imposed by a motor shaft brake.

In the construction of the roller bearing center, the essential features are a cylindrical rocker bearing of the turntable on the upper plate, a construction of the two center plates which gives a deep oil reservoir in the lower plate and a strong and stiff upper plate (which must transmit the central load to the roller track), and a roller construction which provides effectively for division of the load and for adjustment. Transmission of lateral forces through the center is taken care of by a bronze-bushed pintle engagement of the two plates.

The roller tracks (Fig. 2) are made of tempered cast steel, while the rollers are forged. The rollers are mounted loosely on pins which engage a stiff inner live ring and hold the rollers against outward movement by bronze washers mounted in an outer live ring and capable of adjustment out or in by a castle nut working on a fine-thread pitch on the pin. The roller assemblage is free of any connection with the pintle, and can adjust itself to symmetrical load distribution. Four anchor bolts hold down the lower center plate. For anchorage against horizontal thrust, four anchor lugs bolted to the lower side of the bottom plate enter recesses in the supporting masonry where they are grouted in position. A sectional hood bolted around the outside of the upper center plate gives access to the roller adjusting nut and protects the bearings against the entrance of dirt.

The first table of this type was put in service by the Wheeling & Lake Erie R.R. at Gambrinus, Ohio, in 1921. This was a 100-ft. turntable, doing service for which a 110-ft. tipping table had been projected. Several other tables are in operation on this road, on the New York Central, and on the Boston & Maine, and a dozen or more are under construction. An 85-ft. table of this type but with roller-bearing truck axles has been constructed for the Central Vermont R.R. Roller-bearing axles are considered desirable where it is expected that a table may have to be operated by hand at times.

Some figures on power consumption were obtained in a test of a 100-ft. table on the New York Central at Suspension Bridge, N. Y., which had been designed for a full rotation in 2 min. Measurements made with a table empty and with a 142-ton locomotive both balanced and close to one end showed periods of 1 min. 37 sec. to 1 min. 59 sec. for a full rotation, and power consump-

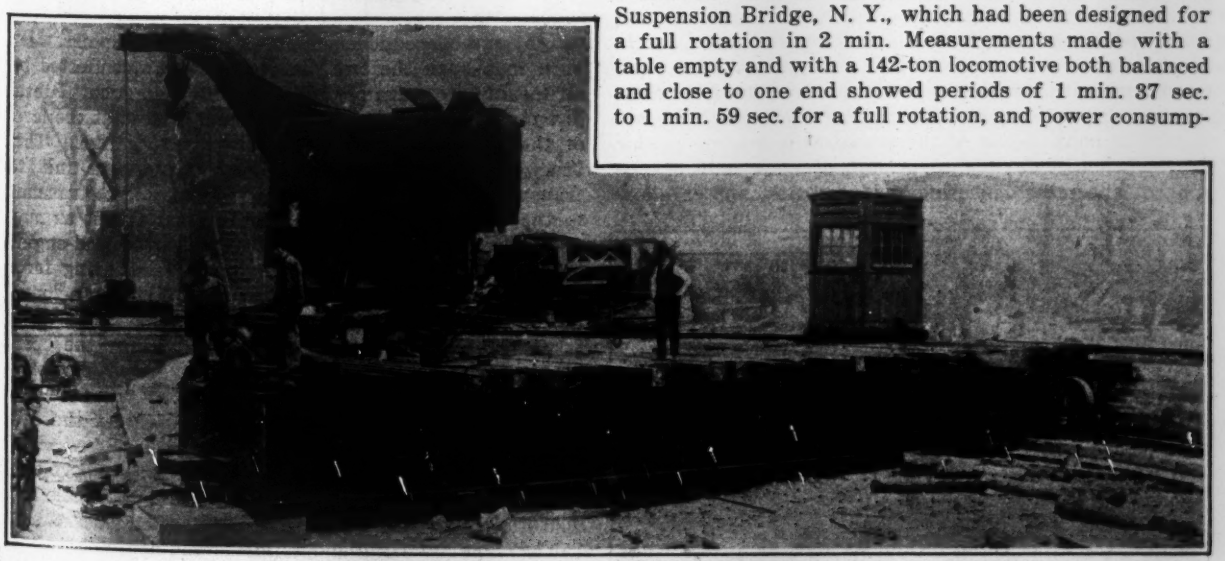


FIG. 3—ERECTING TWIN-SPAN TURNTABLE

One span in place carried on circle rail and by loading girder on center bearing. One truck for other span shown at left. Old turntable removed is at right of derrick car.

tion ranging from 8.6 to 19.0 hp. while running and 20.2 to 57.5 hp. when starting the table.

Twin-Span Turntables—The 100-ft. non-balancing turntable having a 5-point support, installed on the New York Central R.R. at Corning, N. Y., is an example of the comparatively new twin-span type of turntable. In this design, both live- and dead-load are distributed equally between the circle rail and the center bearing. The table in question is designed for a 450-ton engine in any position and its weight is about 70 tons in working order, including the motors, gearing and wheels.

In the twin-span design the usual pair of full-length girders is replaced by two short girder spans connected to a transverse loading girder which is mounted on the center bearing. Fig. 3 shows one of these tables partly erected, one span, or half the table, attached to the transverse girder which is seated on the center bearing. Fig. 4 is a view of the loading girder and center bearing. The connections of the span to the loading girder are sufficiently flexible to permit of each half of the span of the table deflecting independently and to allow for possible settlement in the center foundation. This flexibility also compensates for irregularities in the surface of the circle rail. Movement at the center hinge is minimized by centralizing it about an axis at approximately mid-depth of the span, at which level the lateral bracing is placed. This bracing is made continuous for the full length of the table as shown in Fig. 5.

Among the advantages claimed for this type of turntable are lower first cost for the total installation of pit and table, convenience of operation, and lower expense for operation, maintenance, and repair. With two half spans the girder depth and pit depth may be less than for the usual spans, while the use of standard railway car wheels, journal boxes and bearings reduces the cost. Load distribution reduces bearing weight and consequently reduces wear and repairs.

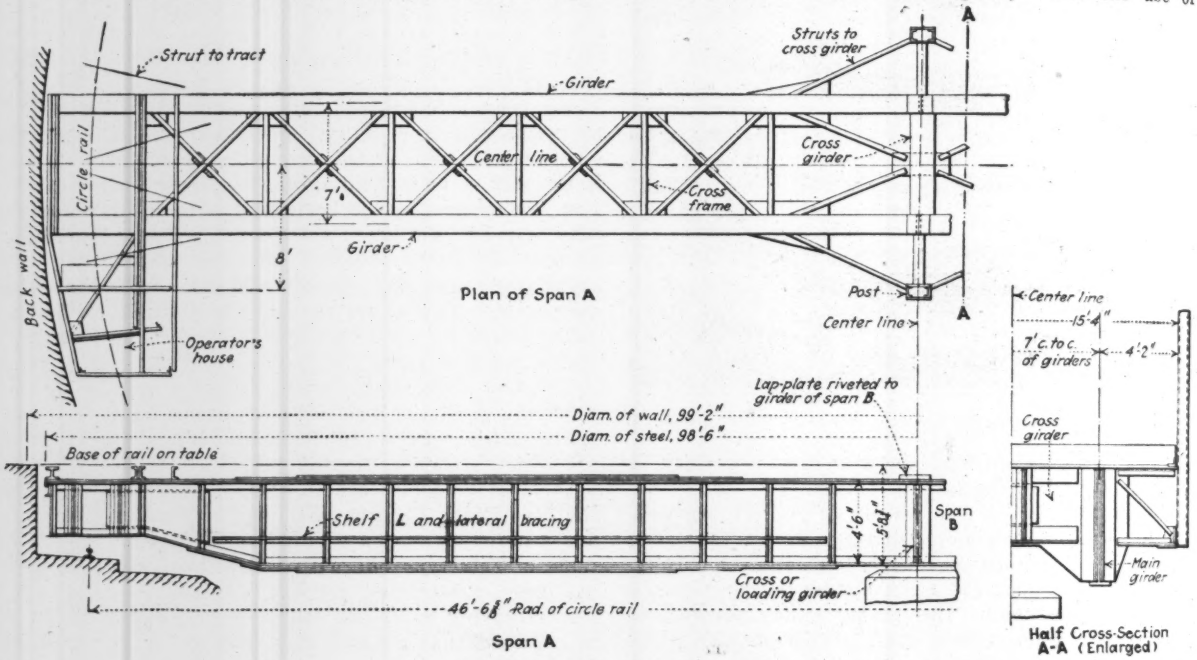


FIG. 5—DETAILS OF TWIN-SPAN TURNTABLE

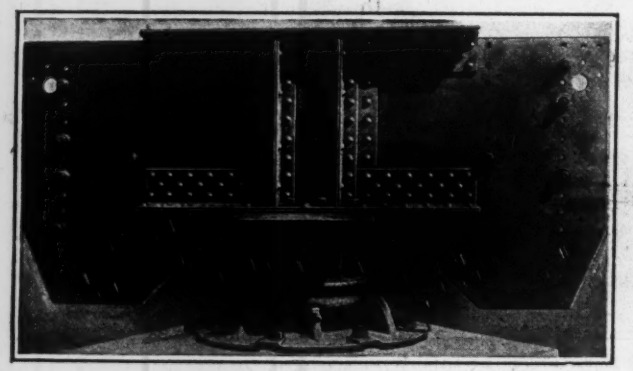


FIG. 4—CENTER BEARING FOR TWIN-SPAN TABLE

In each span the two plate girders are connected by struts or cross-frames and also by diagonal lateral bracing attached to shelf angles and located at the level of the no-flexure axis in the transverse girder. This bracing serves to connect the two spans as a unit, to transmit power forces from end to end, and to transmit to the center bearing such longitudinal thrust as may result from braking forces or the pull of a dead-engine hauler. It is designed for a transverse shearing force of 25,000 lb. at each end of the table and for a longitudinal force of 200,000 due to braking. Cantilever frames at diagonally opposite corners carry the operating cab and part of the suspended motor platform. At the end opposite the cab, the cantilever frame carries a concrete block equivalent to the weight of the cab, in order to give equal tractive effort at each end.

The dead-engine hauling device mentioned above consists of a drum and cable mounted on the turntable and operated from the motors by means of clutches.

The table has rigid end supports and does not rock or tilt, so that it requires less than the usual width of gap between table and pit wall. As it consists prac-

tically of two short simple spans, it can carry overload in the same way as similar bridge spans, and engines may be run over it at considerable speed without damage to the table or its machinery.

A center bearing designed to take the longitudinal thrust due to engine braking is a special feature of the turntable. The bearing is of the flat disc type with a loose phosphor-bronze disc riding freely between polished cast-steel surfaces in an oil chamber which is so trapped that if the pit should be flooded, the oil would remain in place. On the foundation pedestal is anchored a heavy base casting which is formed with an 18-in. pintle, surrounded by an annular groove. Over this pintle fits a casting like an inverted pan, having the inside of its annular flange faced with a bronze ring which rides against the pintle and thus transmits end thrust to the base casting. The horizontal contact surfaces of the two castings between which rides the phosphor-bronze disc are polished and oil is fed to them through holes in each casting. Owing to the distribution of the load, however, the weight carried by the center bearing is relatively light, being given for a specific case as 2,150 lb. per square inch on the bronze disc.

To equalize the load on the disc bearing there is a horizontal 4½-in. pin between the top casting and a shoe bolted to the cross girder. By raising the table just sufficiently to remove its weight from this pin bearing, the shoe pin can be withdrawn and the shoe and top casting then removed to permit inspection or repair of the bearing plate.

Heavy construction of the end trucks is necessary on account of the proportion of the total load transmitted to the circle rail. At each end of the turntable are two two-wheel trucks, each having a single cast-steel frame, H-shaped in plan, with two wheels between the side pieces. The girder is trunnioned on the truck frame. Thus the truck, which is placed exactly radial, equalizes the load on the wheels and the wheel bearing on the single circle rail allows the truck to take the deflection of the girder. The wheels are mounted on short axles with bearings in journal boxes from which the truck frame is supported by heavy column bolts passing through loading caps on top of the boxes. No springs are employed, so that the ends of the table are supported rigidly by the circle rail. A pair of diagonal struts is attached to each main girder and to the end of the truck to serve as collision struts. Steel car wheels, 36 in. in diameter and having the flange cut away and the tread turned to a cone conforming to the diameter of the circle rail, are used for the trucks. The wheels, journals, bearings and boxes are of M.C.B. standard type.

One of the outer wheels at each end, at diagonally opposite corners, is driven from a 35-hp. motor through a simple train of gears to a spur wheel keyed on the driven axle, as shown in Fig. 6. Either motor will turn the table with the heaviest locomotive. The motor and gearing are carried by a structural platform having one end suspended from the driven axle and the other from cantilever beams on the deck of the turntable. The load is so distributed that the two driven wheels carry about 35 and 25 per cent of the total weight on the trucks with the turntable empty and loaded respectively.

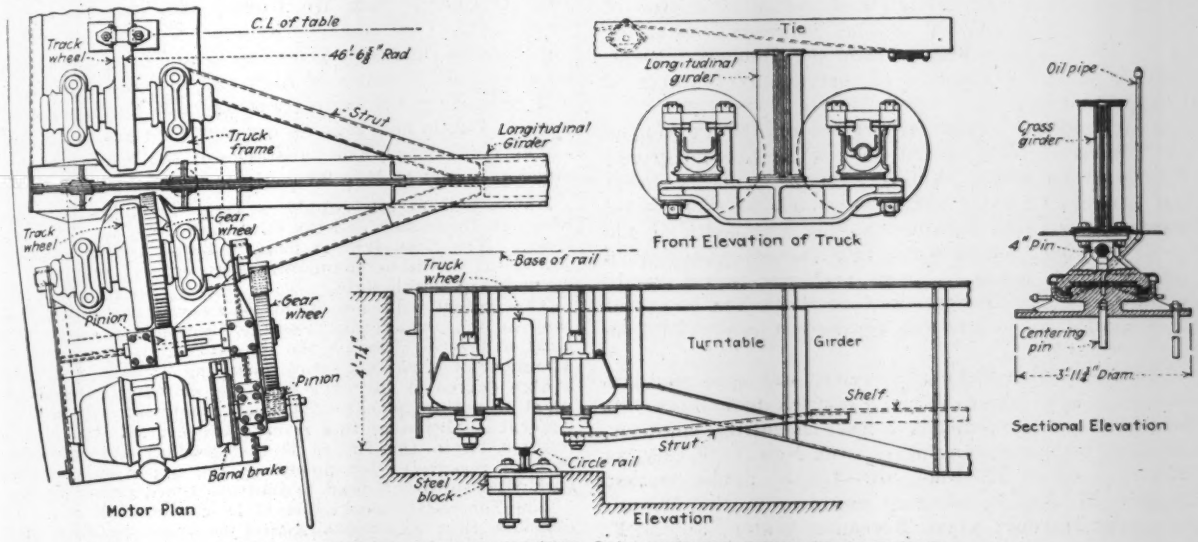


FIG. 6—DETAIL OF THE CENTER AND TRUCKS, TWIN-SPAN TABLE

With a heavy engine in position, the turntable can be swung through 360 deg. in 100 seconds with either one or both motors, as the alternating current compels uniform speed. With direct current, the speed depends upon the loading and the number of motors. In operation, only one motor is used as a rule, the other being held in reserve, thus reducing the amount of current required without reducing the speed appreciably, except where direct current is used. Both power units have emergency hand gear attachments, and one is provided with a band or friction brake operated by a foot lever in the cab. No end lock is required, the inertia and journal friction being sufficient to hold the table steady in any position. Current is taken from an overhead wire.

This twin-span turntable was invented by engineers in the employ of the Bethlehem Steel Co., Bethlehem, Pa., which company owns the patents. About twenty turntables of this type are now in service.

Philadelphia Advised to Spend $99,000,000 for Water

Meters, Improvement of Delaware River Plant and New Pumped and Filtered Supply to Give Altogether 500 M.G.D.

RECOMMENDATIONS designed to provide Philadelphia with a water supply of 500 m.g.d. in 1975 at an estimated cost of $99,000,000 were made in a report by an engineering commission submitted to the Mayor of Philadelphia on May 22, as outlined briefly in our news section last week. The earliest feasible abandonment of the Schuylkill River as a source of supply and enlargement of the Torresdale filtration plant, which draws water from the Delaware River, together with the adoption of meters, are features of the report.

Interconnected storage reservoirs on the Perkiomen and Tohickon creeks would have a combined capacity of at least 85 billion gallons. Pumps near the lower dam would lift water to filters which in turn would deliver water to an aqueduct having a capacity of 400 m.g.d. It would deliver water into a reservoir at Roslyn Heights from which a deep pressure tunnel would extend to Market St. near the City Hall. The length of force mains, aqueduct, and pressure tunnel would be about 28 miles.

The commission making the report was appointed last February, soon after Mayor Kendrick took office. It includes three local officials, a local consulting engineer, and three consulting engineers from New York City, as follows: George H. Biles, director of public works; Solomon M. Swaab, advisory engineer to the Mayor; Alexander Murdoch, chief, Bureau of Water; Joseph F. Hasskarl, George W. Fuller, Allen Hazen, and J. Waldo Smith.

Two Earlier Plans—A report made in 1920 by J. W. Ledoux and three of the consulting engineers named above—Messrs. Hasskarl, Fuller and Smith—advised the ultimate abandonment of the Schuylkill River, ultimate change in the Delaware River intake to a point above Trenton, and the gradual development of a supply from Perkiomen, Tohickon, and Neshaminy creeks, beginning with the Perkiomen. Pending the ultimate changes, the present supplies from the Schuylkill and Delaware Rivers would not only have been continued, but would have been increased according to the recommendations of the 1920 report. A construction program involving a $35,000,000 outlay within the five or six years following 1920 was given in the report, which was abstracted at length in *Engineering News-Record*, Oct. 14, 1920, p. 751. The 1920 report was endorsed by Carleton E. Davis, chief of the Bureau of Water at that time and until his resignation in June, 1923. The successor to Mr. Davis, F. C. Dunlap, soon announced proposed changes in the plan of 1920. Just before retiring from office on the change in administration and being succeeded by Alexander Murdoch, Mr. Dunlap submitted a report, in which he recommended the abandonment of the intakes on both the Schuylkill and Delaware Rivers and the substitution of a new intake from the Delaware River above Trenton, combined with an 18- and a 33-billion-gal. storage reservoir on Neshaminy Creek. The estimated cost of a 600-m.g.d. supply from these sources, assumed to be ample for a population of 4,000,000, was put by Mr. Dunlap at $60,000,000 (this scheme was outlined in Mr. Dunlap's annual report for 1923). Mr. Dunlap estimated that 250 m.g.d. could be developed on the Perkiomen and Tohickon creeks at a cost of $71,000,000 (for summary of the Dunlap plan see *Engineering News-Record*, Feb. 14, 1924, p. 290).

On May 26 steps were taken to provide $10,000,000 to make a start on the new water supply plan in a proposed $40,000,000 bond issue to be voted upon by the people of Philadelphia next November. Of this sum, it is stated that $7,000,000 would be devoted to increasing the supply from the Delaware River at Torresdale, and on the following day one of the Philadelphia papers carried statements from Mr. Dunlap attacking the recommendations of the so-called Kendrick Commission, claiming that the Delaware River intake at Torresdale should be abandoned because of high and increasing pollution and upholding his earlier recommendations mentioned above. Public hearings on the new plan are to be held.

The New Plan—The substance of the Kendrick Commission report of May 22 is given below:

About half of the supply is taken from the Delaware River at Torresdale and the other half from the Schuylkill River. The Schuylkill is badly polluted and is becoming worse. It should be abandoned as a source of supply at the earliest practicable date.

The present pollution of the Delaware River is less than that of the Schuylkill. Sewage treatment is now practiced at several cities on the Delaware and is proposed for a number of important cities, including Trenton, and, while a high degree of efficiency from the drinking water standpoint is not to be expected, such treatment will help the general condition of this river. Another aid that may be counted on in the future is the gradual development of storage reservoirs for power on the upper Delaware, as such reservoirs will tend to increase the dry-weather flow.

The Torresdale works should be continued in use. We estimate that $7,000,000 should be spent on this plant, which will not only improve its efficiency, but will permit the output to be increased from about 175 to 240 m.g.d., against a present consumption of about 325 m.g.d. We believe that there is much unnecessary waste from unmetered services and otherwise. The amount reasonably to be provided 50 years hence, or about 1975, with the complete early adoption of the meter system, is 500 m.g.d., of which we conclude that about half will be produced by the Torresdale plant, with the improvements and extensions to be provided, and that the remainder must be provided by a new source of supply.

By metering and by increasing the production at Torresdale to the economical limit the amount of water that must be provided by the Schuylkill plants will be reduced to a minimum.

The quality of water that a filter plant is able to produce is, in a measure, inversely proportional to quantity. By reducing the load on the Schuylkill plants they will be able to produce materially better water. It will take some years—let us say six or eight—to build the works to provide the water that is to replace that now obtained from the Schuylkill River. During this interval the Schuylkill plants must be kept in service, and such repairs and improvements must be made as are necessary to keep up the highest practicable standard of output.

Several distant sources of supply as substitutes for the Schuylkill are considered in the report but dismissed as more costly than the plan recommended, or involving interstate complications. Ultimately the Upper Lehigh and Delaware Rivers may be drawn from "but the distances to them and the costs of the necessary aqueducts are so great that, for the present, nearer sources should be utilized."

Proposed Improvements at Torresdale—The first step in the proposed program would be to increase the present Delaware River supply by enlarging the Torresdale plant. On this the report says:

It is proposed to rebuild the preliminary filters or scrubbers, making them fully equivalent to the best mechanical filters, to provide new coagulating basins and appliances for treatment and to apply, as at present, the effluent from the preliminary filters to the slow sand filters, which are in good condition and which will serve to complete the treatment. The system of double filtration which will be made fully effective by these changes is in successful use in a number of American cities for treating polluted river waters, and it has been for many years used in Europe. The water obtained now from the Torresdale plant is generally satisfactory and will be thoroughly so after the completion of the works herein recommended.

Perkiomen-Tohickon Project—To bring the 240-m.g.d. yield of the enlarged Torresdale plant up to the proposed 500-m.g.d. various possibilities of developing the Perkiomen, Tohickon and Neshaminy creeks, the latter "with or without augmentation from the Delaware River," were considered. Of these, the report states, a combination designated the "Perkiomen-Tohickon project will provide the necessary quantity of water at reasonable cost" and is recommended. The project is outlined as follows:

The catchment areas from which water will be derived under this project are at present occupied by a rural and village population. The areas on which the reservoirs are to be built and the surrounding margins will be acquired and owned and controlled by the city of Philadelphia. The remainder of the catchment area and the population living on it will be under the laws and regulations of the state to prevent the pollution of public water supplies.

The waters of Perkiomen Creek can be collected by one dam or by six dams and the waters of Tohickon Creek can be impounded by a single dam.

From the standpoint of dams and structures alone it would be better to build one large rather than six smaller dams. One large dam would unquestionably have been selected were it not for the fact that by building it several villages would be submerged and several miles of the Perkiomen R.R. would have to be relocated.

It has frequently happened that, in carrying out a water supply project for a large city, it has been necessary to submerge and destroy villages. When this has been done the rights of the residents are fully protected and there is no reason why a project should be given up solely because it will be necessary to move a certain number of people. This commission believes that matters of engineering and public policy have to be seriously taken into account and weighed one against the other. In this case the importance of the villages involved is so great that we have laid out a plan of development to leave them undisturbed.

Why Neshaminy-Delaware Scheme Not Advised—This commission has carefully considered the project of obtaining a supply of water from Neshaminy Creek, supplemented by pumping from the Delaware River. The Neshaminy is lower in elevation than the Perkiomen, and in making comparison with the Perkiomen it must be taken into account that the pumping cost will be somewhat greater. When this greater pumping cost is brought into the calculation there is no advantage at present-day prices in the Neshaminy against the Perkiomen project. The relative merits are therefore to be decided by other factors than cost.

We assume at this time that the city of Philadelphia will be able to draw all the water that it may need from the Delaware to supplement the natural flow of the Neshaminy Creek, which would amount to something like 170 m.g.d. The character of the water of Neshaminy Creek is about the same as that of the other streams that have been a determining factor. [The Neshaminy-Delaware plan is the one mentioned above as having been recommended by Mr. Dunlap.—EDITOR.]

Larger Dams and Higher Elevations—The Perkiomen-Tohickon project "differs from projects previously recommended in that several of the dams are larger and permit of storage of water at higher elevations and are located in such a way as to make available more water than has heretofore been estimated from this source." Tunnels and conduits would connect the several reservoirs and bring all the water collected to one of them, from which it would be pumped to a filter plant connected by a gravity "aqueduct to a new service reservoir to be located at a suitable site to provide storage and to equalize fluctuations in the amount of water used hourly in the system."

For the immediate future the commission advises a 100-m.g. service reservoir, realizing that in itself a reservoir of such a size would be insufficient but taking "into account that several existing service reservoirs would be fully available, and that some of the raw water reservoirs and sand filters of the Schuylkill plants could be made available for the storage of filtered water." The reservoir should be capable of extension later on.

Pressure Tunnel—To bring the pressure on the Philadelphia distribution system up to "standards reasonably expected in American cities" and to meet peak loads without "very large or very numerous pipes," the following plan is outlined in the report:

It is proposed to bring the Perkiomen water through a new distributing reservoir connecting with a pressure tunnel extending to some point in the neighborhood of City Hall, which will deliver water with a minimum friction loss. This will connect with all existing pipe lines and permit a greater and steadier pressure of from 60 to 80 lb., more or less, or more than double present pressures, to be maintained throughout the business district and the southern part of the city.

Including this feature in the works adds a substantial sum to their cost, but in no way can the large additional quantity of water be delivered satisfactorily throughout the area that will need it.

This increased pressure will give increased capacity to all existing and future pipes, and will reduce by a very large sum the amount that must be spent on increasing the distribution system through a term of years. It will also result in economies in the operation and maintenance of the system. This is not reflected in our financial statement, but is one of the numerous credits that will grow out of the general improvement to the supply system.

The increase in pressure will, we believe, save the citizens through a term of years much more than the cost of the tunnel in reduced fire losses and insurance.

Cost of Project—The estimated cost of the Perkiomen-Tohickon project, "complete, at present prices," with allowances for engineering, administration and contingencies, is $91,500,000, of which $16,500,000 represents work that might be postponed. The work at Torresdale and the improvements at the Schuylkill plants to meet temporary needs are estimated to cost $7,500,000 additional.

Meters—On metering this sentence may be quoted [italics ours]: *"To prevent waste and to reduce the cost of an improved supply and to more equitably proportion the water expense, we recommend meters be installed on all services immediately."*

Acknowledgments—In conclusion the commission expresses "its hearty appreciation of the services of Prof. George C. Whipple, W. Donaldson, C. A. Emerson, J. F. Sanborn, J. Ross Corbin, S. M. Van Loan and particularly John S. Ely."

Wind Overturns Indian Train

The blowing over of trains by high winds is a type of accident of rare occurrence, and the latest case on record was in India in March, 1924, on the Ramganga River bridge of the Oude & Rohilkhand Ry. Investigation showed that the five rear cars were not derailed but were overturned bodily by a violent storm which was so sudden that the engineman had no reason to hesitate about crossing. The bridge, which has thirty-three deck girder spans of 60 ft. in the clear, has rails for mixed tracks of 5 ft. 6 in. and meter gage. The track was found in perfect condition.

Standard Detour Marking System On Ohio State Roads

Markers Designed, Fabricated and Located With Care Precisely Equal to Permanent Road Signs for Travel Both Ways

By G. F. Schlesinger
State Highway Engineer, Columbus, Ohio

THERE IS perhaps nothing in connection with highway construction which causes so much dissatisfaction and adverse criticism as unintelligent detour marking. At best a detour is an annoyance and an inconvenience, and an improperly-marked detour is an abomination. The proper marking of detours is of even more importance than the marking of the main routes. It is often easy to follow a main route, but it is even more easy to get lost on a poorly-marked detour. Also the proper marking of detours requires the exercise of judgment. It should be kept in mind that the signs are for the benefit of the stranger who knows nothing about the route of the detour and they should be so located that they cannot be missed. In Ohio the following instructions for closing roads and marking detours must be followed in all particulars.

Standard Signs—The standard signs provided for marking detours are five in number, as follows: (1) Pre-warning sign; (2) Road Closed sign; (3) Closed sign; (4) Detour sign; (5) End of Detour sign. All the signs are finished in black on a vivid yellow background giving them a distinctive appearance and making them highly visible. These signs are shown by Fig. 1.

The *pre-warning* sign is a standard sign with the legend "Detour—500 Feet Ahead." It is used to warn of the proximity of the detour. Its dimensions are 24x24 in. and it is painted on a standard slow-sign board.

The *road closed* sign is not, strictly speaking, a detour sign but is included in the detour classification because it is to be used only in connection with a detour. This sign is 24x36 in. and it is made of sheet metal. In use it is tacked on a board of the same dimensions, shown by Fig. 1. Both the "Road Closed" sign and the "Detour—500 Feet Ahead" sign are painted board signs.

Detour and *end of detour* signs are used to direct traffic around the detour and are light sheet metal signs 18x27 in. in dimensions.

Except in emergencies all detour signs must be in place before the road is closed to traffic. Before the detour signs are erected, it is of course necessary to select the detour. In choosing the detour, account is taken of the amount of the traffic and the condition of the detour road with respect to its ability to stand up under the traffic. In the case of a detour for a heavily traveled main road it is better to route the traffic over a longer detour that will remain in serviceable condition under heavy traffic, rather than over a shorter route which will be in bad condition in a short time. It may be advisable in some cases to provide alternate detours for wet weather and for dry weather. For example, a short earth road detour may be satisfactory during dry weather but may become impassable under much traffic in wet weather. In a case of this kind when the detours are changed it is necessary to change the signs only at the points where the change in detours takes effect.

Location of Signs—All signs are erected on the right of the direction of travel which they are intended to direct. Care is exercised in choosing the locations to place the signs where they are certain to be seen. All signs are placed on individual posts and are never attached to trees, fences or telephone poles. Where detour signs are erected at corners where the detour crosses another road they are placed beyond the crossing. No more than one sign is placed on a post except where a road closed sign and a detour sign are to be used together, as described in the following section.

When a road is closed to traffic a road closed sign with a detour sign beneath it on the same post are erected at the point where the detoured traffic leaves

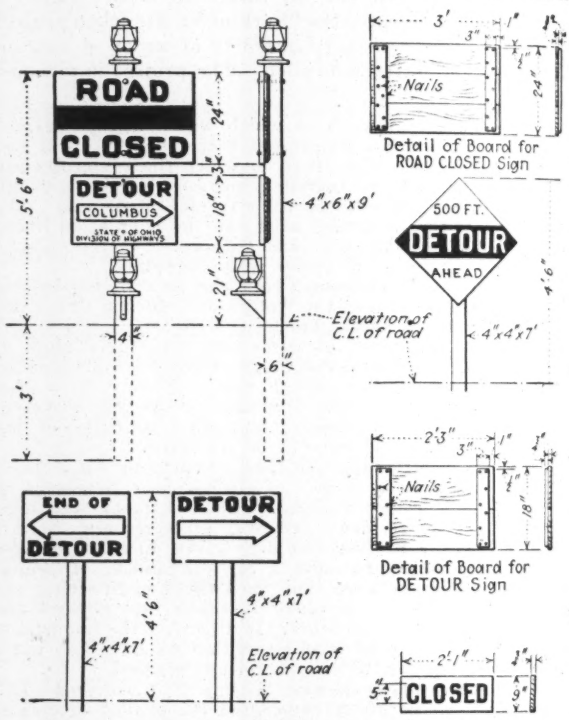


FIG. 1—STANDARD DETOUR MARKERS FOR OHIO STATE ROADS

the main road. The arrangement of these signs is shown by Fig. 1. They are erected just beyond the point where the detour turns off and are placed on or close to the road so that they can not fail to be seen. Two red lanterns are displayed on the post, as illustrated by Fig. 1. If the barricade is located at the point where the detour begins, the post with the road closed and detour signs should be erected immediately in front of the barricade. If the barricade is not located at the point where the detour leaves the main road these signs should be displayed as described above. A road closed sign is also placed on the barricade, if it is not at the beginning of the detour.

Detour signs are so placed that they are on the right side of the road going in the direction of the arrow on the sign; they are placed at cross-roads, forks and at the points where the detour changes direction. The signs at turns in the detour are placed so as to be directly ahead of traffic approaching the turn, if pos-

sible. Where a sign is erected at a cross-road it is placed just beyond the intersection.

The small *closed* sign is used at cross-roads along the detour where it may be necessary to keep traffic coming onto the detour, from the cross-road, from continuing on the cross-road if the latter is closed at its intersection with the main road. At such points the cross-roads are barricaded if possible. If it is not advisable to erect a barricade a wooden horse is placed in the middle of the road. The closed sign should be placed in the middle of the road, on the barricade or horse. Detour signs are placed on diagonally opposite corners of the cross-road properly to direct traffic coming onto the detour. This sign is painted on a board of the dimensions shown by Fig. 1. Stencils for this purpose are furnished by the central office. The colors are black on a bright yellow background.

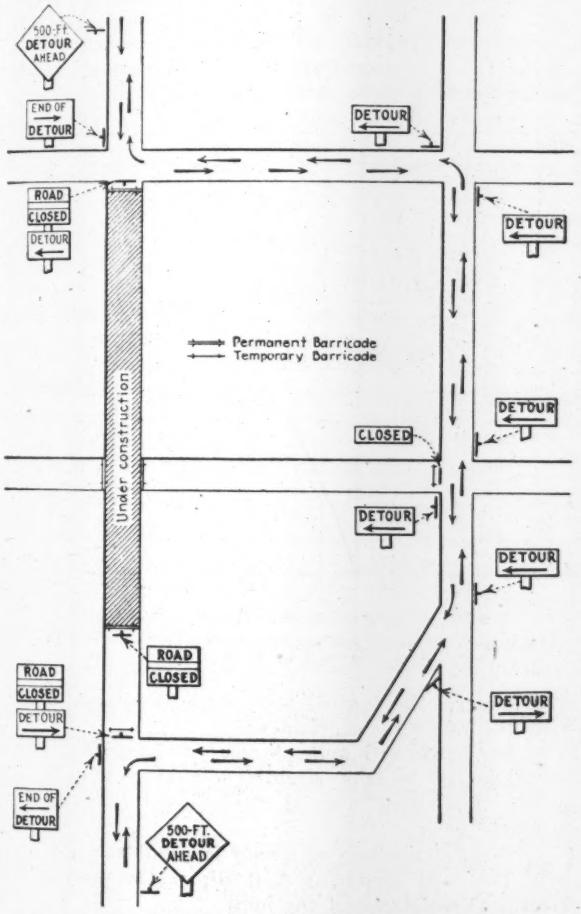


FIG. 2—ARRANGEMENT OF SIGNS MARKING AN OHIO STATE-ROAD DETOUR

The *end of detour* sign is used to mark the point where the traffic comes back to the main road from the detour. It is so located that it will be as nearly directly ahead of traffic approaching it as is possible. A typical arrangement of detour signs is illustrated by Fig. 2.

The *detour—500 feet* sign is used to warn traffic of the approach to the detour and is erected 500 ft. in advance of the point where the detour leaves the main road, and as close to the road as safety permits. In the case of a particularly dangerous condition, such as a bridge out at the point where the detour begins, two signs should be erected—one on each side of the road.

Supports for Signs—All detour and end of detour signs are erected on individual 2x4-in. posts 7 ft. in length. More than one of these signs is never put on the same post. These signs are made of light metal and each sign is securely tacked to a board of the same size as the sign, and the board is nailed to a post. All boards and posts are painted black.

The names of the important towns on either side of the detour are lettered in the arrows on the signs. This can be quickly and easily done by cutting a stencil for each name. Master stencils of the standard alphabet to be used for this purpose are furnished by the central office. By the use of these master stencils a name can be stenciled or outlined with a pencil on a strip of stencil paper, or on detail drawing paper and then cut out. The stencil can be easily transferred to the sign by the use of a narrow plush roller using black paint in paste form. A small amount of paint should be spread on a sheet of metal or glass and the roller moved back and forth over it a few times. The ties in the stenciled letters are connected by using a small brush. Care is taken to do this work as neatly as possible. It may be necessary to remove the gloss from the sign with a piece of sandpaper to make the paint adhere. Rollers and paint are supplied by the central office.

All the signs used for marking detours are erected at such height that they will be in the range of lights at night. This will make the height of the sign about 4 ft. 6 in. above the center of the road, except in the special case of a road closed sign and a detour sign on the same post. In this case the top of the road closed sign should be about 5 ft. 6 in. above the center of the road.

All barricades are whitewashed or painted white. At all times betwen sunset and sunrise red lights are maintained on the barricades and on the signs at the beginning of the detour.

As signs are likely to be destroyed by vandals or other causes, they are inspected at frequent intervals for the purpose of making necessary repairs and replacements. When a road is opened to traffic all detour signs must be promptly removed.

Cave-In on Barcelona Subway Kills Five

Special Correspondence

Barcelona, the commercial capital of Spain, has had its subway under construction for some years, connecting the surface railways entering the city from the east and west. The tunnel section underruns the old part of the city and is assumed to have been cut through foundations which would not hold up under the thin shell left for the roof. At all events on April 12 a portion of the vault in the very center of the mediaeval city fell in leaving a large breach in the street and footways above, as well as in the emplacement where were stored construction equipment and material used in the work. Of the surface crew, thirteen laborers were hurt, while of those working underground five were killed and twenty-five injured. The entire work was intended to be completed in 1925 and while the accident will not constitute a serious setback, it is more than likely that other methods will be employed to avoid similar accidents in the future.

Slip of Riveted Joints in Single And Repetitive Loading

Results of Seventy Tests on Butt Joints Indicate First Slip at Average Rivet Shear of 5,900 Lb. per Square Inch

By David H. Blakelock
Captain, 14th U. S. Cavalry, Chicago, Ill.

IN A SERIES of tests on riveted joints recently made at Cornell University a total of seventy specimens were tested in tension.

The specimens were butt joints, of medium-carbon structural steel, shop-riveted with ¾-in. rivets, and were fabricated at the Elmira Plant of the American Bridge Co. The specimens were of three different types, with 4, 6 and 8 rivets to a joint respectively. Each type was made up with four different thicknesses of main plate, varying from ⅜ to ¾ in. by eighths. In the several types the joints were designed to fail in (a) pure shear, (b) pure bearing and (c) a combination of the two. Cover plates were half the thickness of the main plates. Observations were made to determine the frictional resistance of the joint, the point of slip, the amount of slip, and the action of the joints under repeated loads.

The stress producing first slip varied from approximately 2,500 to 10,500 lb. per square inch rivet-shearing area. This stress was highest for joints designed to fail in pure shear, and lowest for the joints designed to fail in bearing, while intermediate stresses were observed for the other joints. The average stress for all joints was approximately 5,900 lb. per square inch rivet-shearing area.

It was also determined that the load producing first slip is the value of the frictional resistance of the joint. Fig. 3 shows the slip between main and splice plates for one type of joint.

A typical curve obtained from a repetition test is shown at the right in Fig. 3. It is apparent that the frictional strength of the joint is still effective after the joint has slipped under repeated loads. It will be noted that the upper portion of the repetition curve is very similar to that obtained from a straight tension test. A curve obtained from such a test is plotted with the repetition curve for comparison. Both curves were obtained from tests on the same type of joint.

Fig. 1 shows the same repetition curve broken up into its various component parts. This is for comparison with results obtained in tests by Professors A. N. Talbot and H. F. Moore, published in Bulletin No. 49, University of Illinois, February, 1911. The results of one of their tests are shown in Fig. 2 and the similarity to Fig. 1 is very striking. Both results show that slip occurs at very low stresses and that even after slip the joint retains its frictional resistance, although from the Illinois tests it was found that after continued application of loads in tension and compression the elastic curve gradually became flatter, showing a weakening of the frictional resistance. The amount of slip under various loads is nearly the same for the two tests.

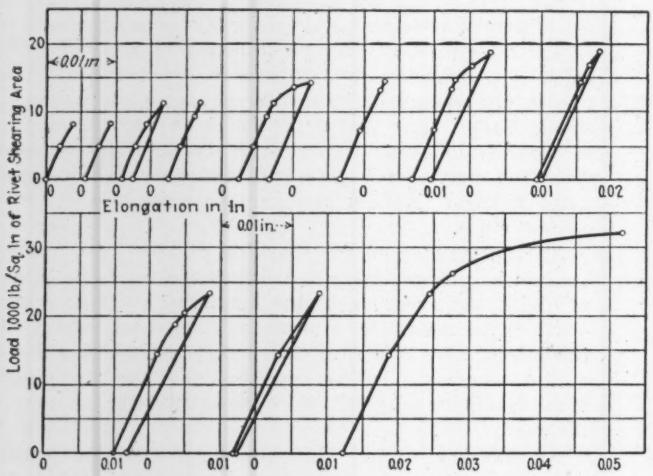


FIG. 1—RIVETED JOINT UNDER REPEATED LOADING

Cornell tests of medium-carbon steel butt joint with 6 x ⅜-in. main plates, splice plates 6 x 5/16, six ¾-in. rivets.

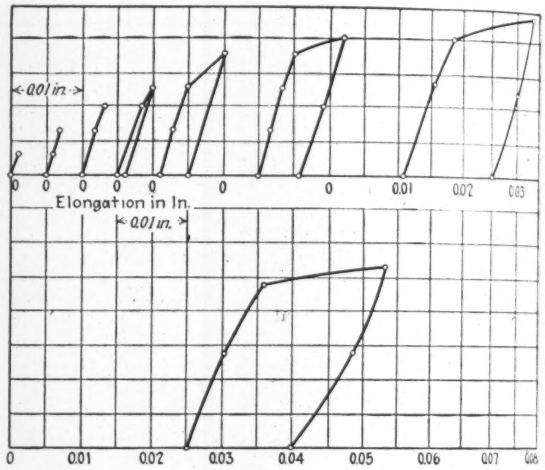


FIG. 2—ILLINOIS REPEATED-LOAD TEST

Specimen TB21L, chrome-nickel steel butt joint with 7½ x 2-in. main plates, twelve ⅞-in. rivets.

In general the Cornell tests were considered to warrant the following conclusions:

1. For joints with multiple rows of rivets the modulus of elasticity is only slightly less than that of the metal. For single rows of rivets however the modulus is much lower.

2. First slip occurs at a very low unit stress.

3. The load producing first slip is the value of the frictional resistance of the joint.

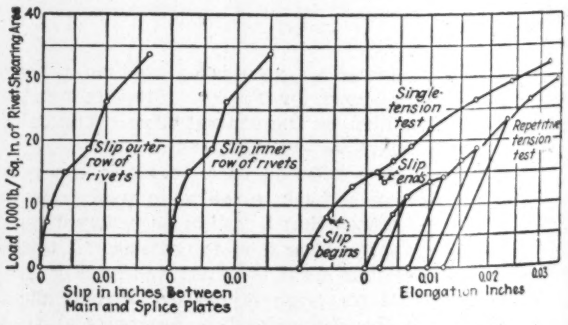

Load 1,000 lb./Sq. In. of Rivet Shearing Area
Slip outer row of rivets
Slip inner row of rivets
Slip begins
Single-tension test
Slip ends
Repetitive tension test
Slip in Inches Between Main and Splice Plates
Elongation Inches

FIG. 3—SLIP OF JOINTS, CORNELL TESTS

Curves at left show deformations at inner and outer rivet rows. Curves at right show repetitive-load test in comparison with single-load test.

4. The frictional resistance is still effective under repeated loadings, after the joint has slipped.

5. Accurate evaluation of the amount of slip is very difficult due to the erratic manner in which it occurs.

6. The stress at end of slip, yield point and ultimate is about 2, 4 and 8 times the stress at the point of first slip.

The tests were conducted by F. E. Conkling, and David H. Blakelock, Captain, 14th U. S. Cavalry, in the Testing Materials Laboratory of Cornell University. Specimens were furnished through the courtesy of J. E. Wadsworth of the American Bridge Co.

Chlorinated Overflow Storm Sewage To Go Into Water Reservoir

BY a five-to-one vote, Springfield, Ill., has organized a Sanitary District of 36.2 sq.mi. area to build a sewerage system, including sewage-works, estimated to cost $2,000,000. The system, which includes several features out of the ordinary, is to conform with a "city plan" and the disposal problem is affected by the necessity of discharging storm sewage into a proposed impounding reservoir of unusual size which is to constitute a future source of water supply as well as a body of water to be used for recreational purposes.

To divert all sewage and storm water from the existing combined sewers out of the drainage area tributary to the future reservoir would be prohibitively expensive, it was shown by a study of several schemes, including a large diversion tunnel, a pumping station and force main. Final recommendation was made in favor of diverting and pumping to the main sewage-works the dry-weather sewage flow at the rate of 300 gal. per capita per day on the basis of the estimated population in 1970. The storm flow, up to 25 times the dry-weather flow, would be freed of settleable solids and disinfected before being discharged into the reservoir.

Springfield is located on a knoll with the Sangamon River valley to the north and east, Spring Creek to the West and Sugar Creek to the southeast. Into these various water courses, eleven main outlets of combined sewers discharge upward of 6 m.g.d. of crude sewage. The water-works is located north of the city. The present supply is from wells, but it is probable that a supply from the Sangamon River will be needed in the near future. A dam near the present water-works is proposed. Four of the existing main sewers, serving about 20 per cent of the population, discharge through Sugar Creek into the Sangamon River above the water-works and above the proposed intake for a future supply. The other sewers discharge westerly into Spring Creek which flows through a beautiful valley and enters the Sangamon below the water-works. To meet these conditions, the following works were recommended:

1. An activated-sludge plant to serve the entire city, located in Spring Creek valley northwest of the city, with a capacity of 11.25 m.g.d., to serve 90,000 people.

2. A west side intercepting sewer with a capacity of 425 gal. daily per capita of the 1970 population. Sewage from a small area at the upper end will be pumped into the sewer. The capacity of the sewer was fixed to take sufficient sewage out of the creek to prevent pollution.

3. On the east side the intercepting sewer will have two sections. The first section will connect all existing combined sewers and will collect from them 25 times the dry-weather flow. At the point of concentration, 300 gal. per capita of the 1970 population will be pumped into a high-level intercepting sewer extending to the proposed treatment plant and so below the water-works intake. This sewer will also serve newly developing areas in the northeast part of the district where separate sewers are recommended. The excess over pumpage at the point of concentration will be settled and chlorinated before passing into Sugar Creek on its way to the Sangamon. The point of concentration and discharge into Sugar Creek is almost 11 miles above the proposed intake and there is no chance of short circuiting this travel.

The sewage reaching the Sangamon above the proposed water intake will thus comprise the untreated overflow from existing combined sewers in excess of 25 times the dry-weather flow and estimated to occur about once every two or three months and the settled and chlorinated sewage in excess of 300 gal. per capita and up to 25 times the dry-weather flow. Among the reasons for recommending this project are these:

(1) The river water supply, when developed, will be filtered and disinfected. (2) An adequate water supply from the Sangamon will require impoundment, thus affording dilution and storage. The reservoir now considered is to hold 3,000 m.g. The capacity of existing sewers in excess of 25 times the dry-weather flow is at the rate of 191 m.g.d.; one hour's overflow will thus be diluted 264 times by the water in the reservoir. (3) Only greatly diluted crude sewage at infrequent intervals will reach the river. (4) Some of the existing combined sewers are too small. Relief sewers will remove surface sewage and thus further reduce surcharge of the interceptor. (5) The cost of an east side interceptor only to carry the capacity of existing east side combined sewers below the proposed water-works intake was estimated at $2,250,350 and of the whole project at $3,316,940.

The activated-sludge plant, with a displacement in the aeration tank of 5 hours and an air-supply capacity for 1.25 cu.ft. per gallon, was selected because power is available at the city light plant at 1c. per kw.-hr., because of ample areas available for lagooning sludge and because of other local considerations.

The Sanitary District boundary line, following quarter, half and full section lines, was planned to include areas which, by reasonable extensions, will secure service from the main interceptors and sewage-works. The engineering work has been done by Pearse, Greeley & Hansen, of Chicago, and Dawson & Walraven, of Springfield.

Use Distribution of Cement in 1922

Engineers of the Portland Cement Association have tabulated, for the benefit of the U. S. Geological Survey, figures on the consumption of portland cement by uses. The following table is taken from a partial reprint of the Survey bulletin "Cement in 1922":

	Barrels	Per Cent
Public and commercial buildings	29,000,000	24.9
Dwellings	11,000,000	9.5
Sidewalks and private driveways	8,000,000	6.9
Miscellaneous farm uses	24,000,000	20.6
Concrete pipe for water, sewers, irrigation and culverts	5,000,000	4.3
Paving and highways	28,000,000	24.0
Railways	6,000,000	5.1
Bridges, river and harbor work, dams and water power projects, storage tanks, and reservoirs	3,500,000	3.0
Miscellaneous uses	2,000,000	1.7
Estimated consumption in 1922, in barrels	116,500,000	100.0

Lighthouse Service Develops Hygroscopic Fog Signal

Operation of Signal Controlled by the Humidity of the Atmosphere—Striking Hammer Run by Small Electric Motor

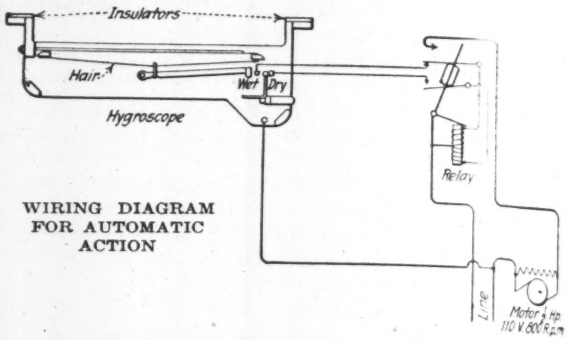
A FOG SIGNAL controlled by the variations in the humidity of the atmosphere has been installed by the Lighthouse Service of the Department of Commerce at Lambert Point, Norfolk, Va. It consists of an electrically operated fog bell controlled by a hygroscope so arranged that under all conditions of fog, mist, rain, snow, or heavy dew, when the humidity reaches practically complete saturation, an electric contact is made

LAMBERT POINT HYGROSCOPIC FOG SIGNAL

which, acting through a relay, starts a ½-hp. motor driving the fog-bell striker. The apparatus is so timed that the 1,000-lb. bell is struck one blow every five seconds. When the humidity decreases, the hygroscopic element shortens and breaks the contact, thus shutting down the motor.

The bell is mounted on a skeleton steel tower, with the striker installed on top of the bell support, with the hammer hanging down in a position to strike the outside lower edge of the bell. The hygroscope is mounted on the underside of a crossarm, which in turn is on a steel angle upright extending 6 ft. above the bell tower, or about 32 ft. above the water surface. The reason for the height of the hygroscope is to eliminate so far as practicable the operation of the signal during periods when dew is formed close to the ground or water surface.

Human hair, treated to remove all grease and foreign matter, is used for the hygroscopic element. A strand containing several hundred hairs is stretched in a horizontal position over two supports, and a link is suspended at the center, actuating levers which make the contacts. A current of 110 volts passes through the contacts, insuring positive action, and this current operates a magnetic relay of unique design which controls the operation of the motor. As the hygroscopic



WIRING DIAGRAM FOR AUTOMATIC ACTION

action of hair is dependent only on the amount of moisture in the air there will be times when the fog signal is in operation when the atmosphere is visibly clear, but upon investigation it will be found that the humidity is approximately 100 per cent. The signal is silent 78 per cent of the time, according to the records compiled over a period of two years at Lazaretto depot, where the hygroscope was on test. The cost of operation averages $8 per month. The total cost of the fog signal station installation was $1,300.

Street Planning for Relief of Congestion at Bridges

Widening of Approaches—Variable-Speed Traffic Zones—Separation of Rapid Transit Lines Recommended

BY CHARLES WELLFORD LEAVITT
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Abstract of a paper read before the National Conference on City Planning, Los Angeles, Calif., April 9.

VEHICLES crossing bridges have jumped in numbers from comparatively few in 1900 to many today. Vehicles crossing the Delaware River from Philadelphia to Camden on ferries in 1900 were approximately 900,000. In 1914 the count was about 1,400,000 and so far as can be determined now, the count for 1923 will be around 3,000,000. Those crossing the Hudson River from Jersey City to New York on the five ferry groups in 1914 were 2,839,055 and in 1922, 4,220,717, an increase in eight years of 1,381,662, or an average increase of 172,709 per year. In 1923 the count was 4,477,802, an increase last year of 257,085.

Bridges are being projected and built to relieve ferries, to replace smaller bridges, to provide connection between outlying sections of cities, to provide short cuts and, in remote sections of the country, to provide new and interesting routes for the diversion of the motoring tourist. With traffic jumping yearly in a constantly accelerated curve, how are we to provide for the inevitable congestion coming at these bridge heads? And how are we to make proper bridge approaches, which will help and not hurt the cities concerned?

Realty Values Should Be Built Up—A city plan must have flexibility, or else it is not a good city plan. The location of bridges and tunnels must be considered with reference to traffic. Existing bridges and tunnels must be regarded, if necessary for the good of the future city, as temporary, and full arrangements planned for the possibility of future bridges coming to the bridge locations selected as best for the city's future growth. Arterial roads, at the locations of the new bridges, should be laid out always with a view of disturbing as little as possible the buildings and other improvements existing, and it should be borne in mind that realty values at the bridge heads, particularly, should be built up, not destroyed. For this reason, the directing of traffic to bridges through areas more or less neglected is sound common sense, as well as good technical practice. Frequently, by careful study, it may be possible to open up routes over property that may be more benefited

than injured by this taking, and thus not deprive the city of such ratables. A large plaza at the bridge head is valuable as a feature and makes a fine impression upon the passerby. Such open spaces, in existing cities, cost much money and may not help the traffic congestion.

In the present-day hurry of all kinds of traffic, interruptions to the steady flow are exasperating and are the source of complaints from the users of the traffic artery, and from business located on the thoroughfares, because of the excessive congestion which occurs. To attain ideal conditions and overcome the exasperation of delays, it is necessary to eliminate the cross traffic streams which now cause the large percentage of bridge approach congestion. This crossing of the traffic stream can be relieved by so designing the approach to the bridge span that an undercrossing from one side of the bridge to the other is obtained. Left-hand turns then can be made without crossing a traffic stream either on or off the bridge.

Selection of streets which will carry vehicles to and from the bridge head and not congest the business portion of the city is most desirable. The combined widths of these traveled ways must be more than the traveled way of the bridge by at least three times, to cover the incidental delays of cross traffic, parking, etc., in the approach streets, where there is intermittent traffic which does not occur on the bridge, on which the flow of traffic is continuous. These approaches must lead away with no serious congestion to be encountered within several blocks of the bridge head. In case of congestion, the approach streets may fill up, but not the actual bridge head, which always should be kept free, the flow of traffic on the bridge being maintained constant.

Variable-Speed Traffic Lanes — In regulating traffic, it will be advantageous to direct the slow going vehicles into one lane and the faster moving cars into others; otherwise, the whole bridge and the bridge approaches may become blocked by slow moving trucks. These bridge approach streets and the traveled way of the bridge might be laid off in lanes 9 ft. wide, which is the width generally adopted for motor traffic lines, and marking lines painted on the pavements with the speed allowed. For example, if we have a street 54 ft. wide from curb to curb, with three lanes in either direction, the ones next to the curb might be marked "5," meaning five miles an hour, for the use of trucks or for other vehicles wishing to stop. When a stop is made, it temporarily would block the cars behind, but they might swing to the left and move past the obstruction, then resume their way on "5," unless they could attain a speed of 15 miles, when they would remain on the second lane, which would be marked "15," and where all vehicles would be expected to maintain a speed of 15 miles. Should this not be possible and they were causing delay, they would be compelled to shift into "5." Or, should they find it possible to exceed 15 miles per hour, they would swing to the left into the third lane, marked "25," where the speed would be maintained at 25 miles per hour. Areas into which broken-down cars or slow moving cars can be drawn to one side are important.

Some New York Problems—In addition to the problems facing New York from the approaches to the Brooklyn, Manhattan, Williamsburg and Queensborough bridges, problems which as yet have not been solved, we have the new vehicular tunnel under the Hudson soon to be opened for traffic. Little has been done for the approaches to this tunnel. In New Jersey alone the estimated cost for these approaches and local improvements amount to $29,000,000, a large part of which, if not all, must be spent to give this tunnel its true relative value. What will happen in Canal and other adjacent New York streets when this double stream of traffic from New Jersey begins to flow into Manhattan yet remains to be seen and endured by the New Yorker. Will we have to resort to Mr. Tuttle's scheme of arcades and pedestrian tunnels, Mr. Corbett's scheme for eliminating pedestrians from the streets and moving them up one flight and throwing open the full width of the streets and some of the ground level of buildings to vehicles, my suggestion of expressways, or new streets carried through the centers of blocks and over the cross streets, or all of these and then some?

It is assumed that streetcars, or rapid transit cars, over the bridges would be provided with rights-of-way from the bridge head at least for several blocks distant from the bridge head without encroachment upon the street widths necessary to provide a flow of traffic to and from the bridge, and equal to the carrying capacity of the bridge. Streetcars brought into the approach streets will reduce the carrying capacity of such approach streets materially, and should not be located within the allotted street approaches, nor should streetcars be permitted in the traveled way for vehicles on the bridge roadway.

The Philadelphia-Camden Case—Take, as an example of what can be done in solving a bridge approach problem the case of the bridge approaches in Camden, N. J. Here we find a new bridge, the largest in the world, now under construction, to be completed in 1926 and to connect Philadelphia with Camden. The Camden bridge head is located some three blocks north of the most congested business center of Camden. This bridge will carry not only much local traffic between Camden and Philadelphia, but also much long distance traffic between Philadelphia, Trenton, New York and the north; Philadelphia, Atlantic City and other seashore resorts and the east; Philadelphia, Gloucester, Salem, Cape May and the southern portions of New Jersey, a densely populated section. It is logical to suppose that Philadelphia will receive and deliver to this bridge all of the traffic from Pennsylvania, Ohio, western New York and other western states, also much of the southern traffic flowing to the New Jersey and New England seashore resorts. The first plan was to cut through the three fine blocks of houses between this bridge head and the center of business in Camden, at a direct cost of several million dollars which, in turn, would deprive Camden of these ratables, and so, in effect, double the expense to the city. After this had been accomplished, an undesirable congestion would have been added to these already overcrowded approach streets, adversely affecting realty values. One needs not imagination to picture Camden actually set back by the new bridge, instead of reaping benefit from the increased taxes paid for the construction of this bridge. Also, she would receive constant complaints from the long distance travellers who would look upon her as only a stumbling block and a disagreeable delay in their way—as is the case at present, on account of the ferry, which must now be used until this bridge is opened to traffic. The narrow and congested condition of the business section of Camden is a hindrance, and must be traversed in order to pass from the ferry to the thoroughfare of the state routes 2, 3 and 6, leading north, east and south.

A solution to the problem presented by these bridge approaches was found by the Crescent Road connection of these routes 2, 3 and 6, outside the limits of the city of Camden and largely through open country, where a roadway 56 ft. wide is planned. On a line bisecting the city from the bridge head to a point on this Crescent Road, east of the city and along the valley of the Cooper River, over terrain now very largely undeveloped, an 86-ft. roadway on a 120-ft. right-of-way is planned. This boulevard will pass by the new site of the civic center and will be the Champs Elysées of Camden. The boulevard, together with the other streets leading to the bridge head, will have a combined width of 296 ft. The roadway on the bridge is 56 ft., so that there appears to be an ample factor of safety for Camden and New Jersey traffic, if these plans are carried out.

Practically no ratables will be eliminated. The right-of-way from these new approach streets will be either donated by the properties through which they pass for the sake of obtaining this increase in value to the property not taken or such low values will be placed upon this right-of-way as to make it a negligible amount in figuring the cost.

One of the bright spots in the annals of city planning was the obtaining of the site for the civic center in Camden. Some forty-five acres recently was bought by C. F. Jenkins, a Philadelphia man, for approximately $450,000, with the expectation of making about $3,000,000 profit when the bridge is completed. When these plans for the civic center were frankly explained to him and he was asked to let the city have this property at cost and carrying charges (as the advanced price would have been beyond the means of the city), he promptly consented, although he had no other interest in Camden, and thus gave up his chance for profit in order to make these city plans possible of execution. A noble deed by a great man! Encouragement is given to those of us who dream and plan civic improvements to alleviate the perils accruing from the congestion of metropolitan districts.

An Economic Study of Dragline Excavator Operation

II—Operating Methods and Costs

Performance, Operating Practices, and Costs Determined by Thirteen Million Yards of Excavation for the Miami Valley Flood Protection Works

By C. W. Ullom
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

IN THE OPERATION of dragline excavators many questions have arisen over the performance possibilities, the most economical methods of handling, cable requirements, and other details. In the present article a resumé is given of the operating experiences on the Miami Conservancy District work [the first article, on Output and Cost Records of dragline excavator operation, appeared May 29, p. 932.—Editor].

Size of Crews—A crew on the large type electric draglines consisted of operator, oiler, pit foreman, and two to four laborers. On the steam machines it was necessary to employ in addition a fireman, pump man, and one extra laborer to assist in carrying the coal onto the machine. The crews worked in two 10-hour shifts, six days each week. Payment was made to hourly rate men on the basis of an 8-hour day, with time and a half for the two extra hours, making the equivalent of eleven pay hours for ten hours of work. Repairs on Sundays were paid for at a double-time rate.

Depth of Cut—The adaptability of the dragline for making deep cuts was shown at Taylorsville, where a Lidgerwood Class M electric machine with 100-ft. boom successfully excavated in the outlet pit, 63 ft. below and 37 ft. above the machine base. Although it might have been possible to dig at still greater depths, the economic depth, limited by the excessive cable wear and the time consumed in lifting the bucket, was probably reached on that work. It is believed that the Bucyrus Class 175 machine, mounted on trucks and with 135-ft. boom, will dig effectively 75 ft. below and unload 80 ft. above its track level.

Time of Swing—The time required for making a complete operation—digging, swinging and dumping—varies with the nature of the material excavated, angle of swing, depth of cut, height of dump and care necessary in dumping. One of the Bucyrus Class 175 electric machines can dig under water in fairly loose gravel, swing 180 deg. and dump into spoil-bank in 50 to 55 seconds. The same operation, with an angle of 45 to 90 deg. with loose, dry material, can be completed in 34 to 36 seconds. The average time of a Bucyrus Class 24 electric machine, digging from borrow-pit and loading 12-cu.yd. dump-cars, was 52 to 65 seconds for the round trip, depending on the angle of swing.

Rate of Travel—At Huffman, during the progress of the work, the average time for moving a Bucyrus Class 24 machine, mounted on skids and rollers, over a distance of 32 ft. and chucking up ready for excavating again, was 40 minutes. At Dayton, a Bucyrus Class 175 machine, truck-mounted, traveled 300 ft. in five hours on a dead-head run. A Bucyrus Class 9½, steam-operated and caterpillar-mounted dragline traveled 2¾ miles through the streets of Dayton at a rate of about 520 ft. per hour. A Monighan, type 3-T walking dragline traveled 1,500 ft. at a rate of 1,000 ft. per hour across fairly level cultivated land. At Hamilton, a Bucyrus Class 14, mounted on skids and rollers, moved 6,000 ft. in ten days, an average move of 300 ft. per 10-hour shift.

Performance on Curves—A Bucyrus Class 175 truck-mounted machine at Dayton traveled around a curve of 135-ft. radius, which is considered about the limit of safe and economical operation for this type of mounting. The same class machine, mounted on skids and rollers, turned 180 deg. on a 75-ft. radius. Considerable difficulty was encountered in making the curve and 40 to 50 rollers were crushed in the operation.

Performance on Grades—A Bucyrus Class 175 truck-mounted machine at Dayton climbed and operated on a 6.5 per cent grade. The machine climbed with great difficulty and some trouble was experienced in swinging with a loaded bucket. The same machine, mounted on skids and rollers, climbed a 7 per cent grade without much trouble. A Lidgerwood Class K truck-mounted machine worked down a 7 per cent grade without difficulty. A Bucyrus Class 9½ caterpillar-mounted machine worked both up and down a grade which averaged 13.2 per cent for 80 ft. but which was 16.2 per cent for half that length.

Passing Under Bridges—In the course of the channel work at Dayton it was necessary that one of the large Bucyrus Class 175 machines make six passages under bridges. Three of these passings were made with the machine mounted on a floating spud scow, one on dry land, and two on land with the aid of cofferdams, with the machine on skids and rollers. In passing while on floating equipment, a Bucyrus Class 9½ machine, also scow-mounted, acted as a tender in excavating a channel under and below the bridge for floating of the other equipment. The boom of the large machine was lowered on another scow, the A-frame lowered, and the whole maneuvered into position and pushed through by the steamboat. It was necessary partly to sink the spud scow with additional ballast to secure the required clearance for the machine beneath the arches of the bridge.

The dry land passings were similar to those at Hamilton, where a Bucyrus Class 24 skid-and-roller-mounted machine passed under bridges, with A-frame lowered, ten times. The grading for the track was done by an auxiliary machine, Marion Model 21 dragline, or with teams. Heavy timbers were used for the rollers instead of mats. A line of 60-lb. steel rail was placed along the center of the track, the lowered boom sheave wheel being supported and running on this track. The machine pulled itself through by the use of its drag cable and a dead-man. The result of experience and of standardizing machine performance is indicated by the fact that the last bridge passing was made in six hours.

Economic Width of Cut—The efficiency of the dragline as an excavating implement is governed to a large extent by the economic planning of its work. Where draglines were used without auxiliary equipment on the river channel excavation, a so-called "one and two thrown" method of handling the material was adopted. The first step in the procedure was a study of the cross-section to determine where to divide the excavation to secure the most economical balance between necessary cut and required fill. The excess of excavation over embankment was wasted in a spoil bank on one side, or if no such spoil bank was available, was hauled away. It was generally found cheaper to handle a limited quantity of material three times rather than install special hauling equipment.

The width of cut which a machine could make and at the same time pile the material in a windrow along the edge of the cut, was dependent upon three factors, namely, reach of the dragline boom, depth of cut, and slope upon which the piled material would stand. It is obviously the most economical plan to place the greatest possible quantity of material in embankment with only one handling, and with two or three handlings for the smallest quantity. Accordingly the machine runs were planned conversely to the actual construction operation, the maximum quantities capable of being handled by the machine being outlined for the final and next to final runs, with the remaining or smaller quantity for the first or mid-river run. Besides giving the most economical results, this method had the added advantage of keeping the excavator in the most dangerous position from the standpoint of flood rises for the smallest possible time. It is worth noting that the proper balance of quantities as outlined on paper worked out remarkably well in actual construction, due regard having been taken as to quality of material and shrinkage.

Where excavated material from the river channel was loaded on cars and transported to spoil banks, as at Hamilton, the economic width of cut was controlled by the following factors: Depth of cut; total width of section to be excavated; distance from machine to track at which cars can be loaded most easily; quantity of embankment necessary for dragline runway; quantity of track embankment and track work; and danger to machine and tracks from high water.

In shallow cuts it is generally most advisable to dig the full possible reach of the machine, and, where the cut is a little too wide for one reach, it may be more economical to throw the material in the extra width over with the dragline than to add another set of car tracks. Where the cut is heavy, say 25 ft., it is probably more economical to divide the full width of the machine cut into two cuts, with two sets of tracks, thus avoiding long swings of the boom, with the resultant loss of time for both machine and cars.

In excavating from borrow pit and loading cars for train haul, the most economic width of cut was found to depend upon the following factors: Depth of cut; time of swing of the machine; time of moving the machine ahead; easiest loading distance; and cost of track work.

At Huffman, time studies were made of the swing of the machine over different sections of the cut, together with the time of moving the machine ahead. From these observations and the cost of track work it was found that, with the Bucyrus Class 24 electric dragline with 100-ft. boom and 4½-cu.yd. bucket, operating in a 25-ft. depth of cut, a width of cut of 125 ft. was most economical.

Dragline Delays—Interruptions in the operation of dragline excavators constitute an essential part of their cost of production. Much study was given on the District work as to the amount and classification of these delays, working toward their reduction to a minimum. Delays may readily be classified into major and minor. Major delays include major repairs and overhauling, accidents with the resultant repair delays, and delays due to high water. All are more or less unavoidable, but the extent of time consumed may be regulated in most instances. Minor delays include minor machine repairs, changing cables, moving the machine, power delays and delays incidental to car loadings. Although the duration of separate minor delays is short, their total for a season's work is generally greater than the total of major delays. The human equation enters largely into minor delays, thus offering a very prolific field for the promotion of more efficient machine operation, and efforts where concentrated on the reduction of this class of delays.

At Dayton, each of the three large machines was equipped with a "service recorder," of the type commonly used in connection with automobile truck operation. All movements of the machine were thus recorded on a revolving chart by a vibrating pendulum. The daily results were charted and the percentages of actual to possible operating time, for each operator and each machine, were compiled weekly and made known to the operating crews. Thus a friendly rivalry between crews was instigated, and the percentage of delays materially decreased. During the season of 1922, the percentage of actual to possible operating time, deducting all delays, both major and minor, for the Lidgerwood Class K, the Bucyrus Class 175, truck-mounted, and the Bucyrus Class 175, skid-and-roller-mounted, was 88, 88½, and 84 respectively. Deducting minor delays only the percentages were 95, 93 and 91. The work was straight digging and casting, no auxiliary equipment being used during this period.

TABLE I—SUMMARY AND CLASSIFICATION OF DELAYS TO BUCYRUS CLASS 24 ELECTRIC, SEASON OF 1921 AT HUFFMAN

Classification	Hours	Per Cent of Total Delays	Per Cent of Possible Running Time
Waiting for trains	660	57.5	12.5
Cleaning loading track	19	1.7	0.4
Moving dragline	171	14.9	3.2
Changing cables	27	2.3	0.5
Mechanical repairs and adjustments	186	16.2	3.5
Electric trouble and repairs	45	3.9	0.8
Power delays	33	2.9	0.6
Unclassified delays	7	0.6	0.1
Total delays	1,148	100.0	21.6
Total actual digging time	4,152	....	78.4
Total possible digging time	5,300		100.0

At Hamilton, where only one electrically-operated machine was used, a voltmeter was located in the office of the construction superintendent, who was thus advised at all times of delays, shut-downs, etc.

At the dams, careful records were kept of the duration and kind of delays. Daily car loadings for each machine were posted and an interest in increased production thus stimulated. Table I is a summary and classification of delays to Bucyrus Class 24 electric dragline, while excavating from borrow-pit and loading cars at Huffman during the season of 1921.

Dragline Cables—A dragline functions to a large extent through its cables. Thus the strength, dependa-

bility, and length of wearing life of the cable used has a very important bearing upon the efficiency and economy of the machine operation. A dragline has three important cables, namely, the boom, drag and hoist lines. The boom line is a more or less stationary line, the wear slight, and its life so long that no records were considered necessary toward determining its cost per unit of excavation. Cable wear on the drag and hoist lines is dependent upon the type of cable, the machine, its operation, and the nature of the material excavated. It will readily be seen that an increase of a comparatively few cubic yards in the yield of each cable meant the saving of a considerable sum of money on work of such magnitude as that done by the District. Consequently, accurate records were kept and investigations made, during the progress of the work, to ascertain the best makes and types of cable construction adaptable to dragline usage, and to learn the best methods of prolonging the life of the various cables.

A drag cable is not ordinarily subjected to sharp bends, the stress being generally a direct pull. The main requisites are great tensile strength and high resistance to abrasion. The major part of the drag cable used by the District was made of improved plow steel, composed of six strands of nineteen wires each, wound around a steel or wire rope center. The hoist-line runs around the boom and padlock sheaves, and, because of this need for greater flexibility, hemp-centered cable was largely used.

So many variable factors enter into the life of a cable that even carefully compiled records are often misleading and apparently contradictory. Most of the governing factors are intangible and cannot be measured by any exact scale. The original cost of cable and the number of cubic yards handled per cable are the only fixed and tangible bases of comparison. Quite a number of cables fail long before their intrinsic wearing value has been utilized, the two chief causes of premature failure being carelessness of the operator and defects in the machinery. However, these premature failures are incidental to all dragline operation, and in making tabulations and comparisons of actual cost of cable per unit of work all cables are included.

Cable records for representative continuous periods on nine draglines used on various features of the District work were used in compiling the composite record of dragline cable efficiency and cost given in Table II. The machines included are: one Bucyrus Class 24 steam-operated, three Bucyrus Class 24 electrically-operated, two Bucyrus Class 175 electrically-operated, one Lidgerwood Class M electrically-operated, and two Lidgerwood Class K electrically-operated.

In earth excavation under conditions where it is possible to develop to a considerable extent the latent wearing powers of a drag cable, tests to determine the efficiency of various types of cable are distinctly worth while. In rock excavation most drag cables are broken prematurely by shocks or abrasion, and it seems most advisable to use cables of a low purchase cost, commensurate with a reasonable degree of strength.

Types of Mounting—The selection of a type of mounting for a dragline excavator depends upon several conditions of operation. Factors affecting a choice are: size of machine, nature of material over which travel is necessary, and depth and width of cut.

For the heavy Bucyrus Class 175 machines, self-propelled truck mounting seems the most desirable. Because of the great weight, caterpillar mounting is probably not practical. Skid-and-roller mounting was used on one of the large machines to secure less height in passing under bridges, but in general was not as efficient as the truck mounting. The cost of crushed rollers during one period of severe service lasting 55 days amounted to $10.30 per day. In wet weather the danger of slipping is greater with skid-and-roller than with truck mounting. The added height of truck mounting gives greater protection from damage when working in areas subject to flooding.

TABLE II—COST AND EFFICIENCY OF DRAGLINE CABLES, EARTH AND ROCK EXCAVATION

No. of Cables	Kind	Material	Maximum per Cable Cu.Yd.	Average per Cable Cu.Yd.	Aver. Cost per 1,000 Cu.Yd.	Aver. No. of Shifts
303	Drag	Earth*	165,000	32,035	$2.85	34
38	Drag	Rock**	17,000	6,940	14.59	18
139	Hoist	Earth*	180,000	60,850	1.92	70

* Earth taken from borrow-pits and river channel was uncompacted gravel overlaid with loam and clay.

** Rock taken from outlet channels was Cincinnatian formation, and was loosened with dynamite.

For the lighter Bucyrus Class 24 and Lidgerwood Class M and K machines, the skid-and-roller mounting seems well adapted and performed very satisfactorily.

On the Bucyrus Class 9½ and 14 and the Marion Models 21 and 36, caterpillar mounting proved most effective. These machines were, in general, required to make numerous dead-head trips in traveling between jobs, and the speed and ease of handling made the caterpillar mounting very satisfactory. Little difficulty was encountered with soft foundations for the machine track, gravel bottom being usually accessible.

Overload on Machines—At Dayton, the desire for increased production led to overloading of the draglines from 30 to 40 per cent, by the use of larger buckets and boom lengths greater than the original design. While the policy of overloading the machines may have been justified on the flood protection work, where time of completion was such an important element, it is doubtful practice on a continuous-work program extending over a long period of years. The wear and tear on the machine is materially increased, and, should material tougher than loam or gravel be encountered, considerable motor trouble would undoubtedly ensue. The fact that the machines in general did perform so successfully under the overloads does not indicate a lack of economy or efficiency in the original design, but, rather, a conservative factor of safety in the design, a necessary reserve of power available in emergencies, wisely built into the machines by the manufacturers.

Electric Losses in Submerged Transmission Cables—On the channel improvement work at Dayton and Hamilton, frequently the track upon which the dragline operated was virtually an island in the middle of the river. Electric current for the machine was transmitted from a bank of transformers, located on the shore of the river, by the use of three 4-0 flexible cables, from 400 to 800 ft. long, and insulated with standard mining cable insulation. These cables were not supported between the transformers and the machines, being allowed to lie upon the bed of the river, and very often were submerged for the greater portion of their length. A test was made to determine the current loss, after the cables became worn and possibly watersoaked through long submergence. Three 500-ft. lengths of

4-0 cable, worn by usage to an average condition, were connected to transformers and submerged for four days before the test was made. A meter was attached to each of the cables in turn and current consumption registered. At the average power cost of 2c. per kilowatt-hour, the cost of current loss per machine per day of twenty hours was computed to be $0.3341. This cost is negligible, compared with the support of the power cables between transformers and machine.

Standardization of Equipment—On the District work in the period of the world war, it was exceedingly difficult to secure delivery on any construction equipment, and as a result draglines were picked up wherever available, some new, but the greater majority having had previous service. While the use of the different makes and types of machines gave an excellent opportunity for comparing the relative merits and demerits of each, it obviously did not tend toward the maximum efficiency or economy of operation. When conditions permit, the advisability of the standardization of dragline equipment is readily apparent. It is necessary that a large stock of repair parts be kept on hand at all times to insure continuous operation of the machines. With machines of the same type, interchangeability of parts means a tremendous reduction in the number of parts necessarily carried in stock, with a corresponding reduction in invested capital and storehouse expense. Transfer of operators may also be made between machines of like type without loss of operating efficiency.

The Transition Lemniscate

Fundamental Principles Outlined—Formulas Give Results with Degree of Approximation of Seven-Place Tables

By Antonio Llano
Montclair, N. J.

THE WRITER developed the theory of the lemniscate as a transition curve in the early part of 1920. However, it is only recently that he has reduced it to its present form, in which, so far as he knows, the curve is much simpler and more elastic than any rational transition curve previously proposed. It has the advantage that any of the quantities involved can be at once determined, either with mathematical exactness or, what is practically equivalent, within the limits of approximation of 7-place logarithmic tables, by comparatively simple formulas without series. A table has been constructed, and formulas derived for the solution of special problems. In this article, only the general fundamental formulas are given. In practice, of course, the principal quantities would be taken from the table.

In Fig. 1, O is the point of tangency of the transition curve s and the tangent OX; M is any point of the curve; c, the long chord to M; r, the radius of curvature at M; MP, the tangent at M, making angles β and φ with c and OX; θ, deflection angle to M.

By making the superelevation proportional to c, instead of to length s of curve, as in the Crandall spiral (either assumption is permissible, both being arbitrary), it is found that cr is constant. For convenience, the constant product $3cr$ will be denoted by k^2. We have, then,

$$3cr = k^2 \qquad (1)$$

This leads to the general equation of the curve:

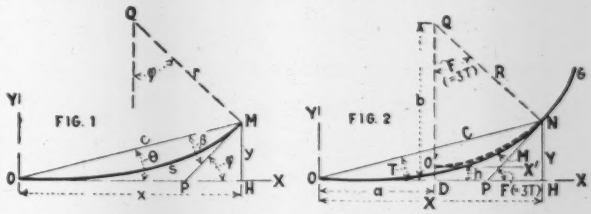
$$c^2 = k^2 \sin 2\theta \qquad (2)$$

From this follow:

$$\beta = 2\theta \qquad (3)$$

$$\varphi = 3\theta \qquad (4)$$

Equation (4) is approximately true in the Crandall



RAILROAD TRANSITION CURVE

spiral, but, except for very small values of θ (up to about 4°), the approximation is rather rough.

The rectangular co-ordinates x and y are computed from c and θ by the elementary formulas of trigonometry.

When r and θ are known, as in the general problem presently to be solved, (1) and (2) give

$$k^2 = 9\, r^2 \sin 2\theta \qquad (5)$$

$$c = 3\, r \sin 2\theta \qquad (6)$$

In Fig. 2, $O'X'$ is the original tangent of circular curve $O'NG$; OMN, the lemniscate; N, the point of tangency of the two; Q, center of circular curve. Quantities for N will be denoted by capital letters, R, C, T, etc., using T and F instead of Greek capitals. The offset $O'D$, or distance between the two tangents, is denoted by h. It is the shifting of the tangent in a direction parallel to itself. The displacement DO of the point of tangency in the direction of the tangent is denoted by a. The co-ordinates of Q with respect to OX and OY are a and b $(= R + h)$.

In terms of C [calculated by (6)], R and T,

$$a = C\cos T - R\sin 3T \qquad (7)$$

$$b = C\sin T + R\cos 3T \qquad (8)$$

In terms of R and T,

$$a = \tfrac{1}{2}R(3\sin T + \sin 3T) \qquad (9)$$

$$b = \tfrac{1}{2}R(3\cos T - \cos 3T) \qquad (10)$$

In all cases, $h = b - R$; or, directly,

$$h = \tfrac{1}{2}R(\operatorname{vrs} 3T - 3\operatorname{vrs} T) \qquad (11)$$

Also,

$$OP = (C/\sin F)\sin 2T \qquad (12)$$

$$PN = (C/\sin F)\sin T \qquad (13)$$

Sometimes h and R are given, to find the other elements of the curve. An exact solution of this problem is out of the question in other transition curves; even using tables, the solution is troublesome. The lemniscate affords a simple and exact solution.

Let u be an angle determined by the equation

$$\cos u = \frac{b\sin 45°}{R} \qquad (14)$$

Then,

$$\cos T = 2\sin 45°\sin(30° + u/3) \qquad (15)$$

Now k^2 can be determined by (5), and the length S of the curve by the formula given farther on for s. If the value of S thus found is not convenient, and a slight variation in h is permissible, find an approximate value of S by the formula

$$S = \sqrt{24hR} \qquad (16)$$

Select a convenient S near this value, determine the other elements by the methods given below, and calculate a new h by (8), (10) or (11).

The foregoing formulas, except (16), are mathematically exact. Those now to be given, involving the length s of the curve, are, as already stated, exact up to the limits of approximation of 7-place tables; or rather, may be made so by carrying the numerical constants (the results of a few simple multiplications and divisions, mainly to change radians to degrees) to seven places. Here they are carried only to five, for five-place tables. The degree of approximation mentioned applies for values of F up to about 52°—an almost imaginary case. For this value of F, formula (22), with constants to seven places, gives T with an error of less than 0.3″. In all the formulas, *angles are in degrees.*

When, as in the case in which R and h are given, S cannot be assumed, it is found by applying the general formula

$$s = k \sqrt[4]{\frac{1218.5}{(1000/\theta)^2 - 81.23}} \qquad (17)$$

Usually, R is known and S is assumed. Let v be an angle determined by the equation

$$\cos v = S\sqrt{5}/10R \qquad (18)$$

Then,

$$T = 128.12 \sin (30° - v/3) \qquad (19)$$

$$k^2 = 9R^2 \sin 2T \qquad (20)$$

The intermediate deflection angles must next be determined. Let S be divided into n equal lengths, and put $S/n = s_1$. Let θ_m be the deflection angle to the mth point of division, counting from the origin. Put

$$28.648 s_1^2/k^2 = P \qquad (9P/1000)^2 = Q \qquad (21)$$

Then, in all cases,

$$\theta_m = \frac{P}{\sqrt{(1/m)^4 + Q}} \qquad (22)$$

If m^2 is less than $27/10P$

$$\theta_m = Pm^2 \qquad (23)$$

The last formula assumes that angles are to be computed to the nearest tenth of a minute. The error is less than 0.05′, or 3″. The test is applied roughly—usually mentally.

Formula (22) is very readily applied with a small table for $(1/m)^4$, like that here given. The figures in parentheses indicate number of ciphers between decimal point and first significant figure. Thus, (3)77160 = 0.00077160.

RECIPROCALS OF m^4

m	$(1/m)^4$	m	$(1/m)^4$
2	(1)62500	6	(3)77160
3	(1)12346	7	(3)41649
4	(2)39062	8	(3)24414
5	(2)16000	9	(3)15242

As an illustration, let us take a 10° curve ($R = 573.14$ for 50-ft. chords) with a 400-ft. lemniscate—an unusual case.

Formulas (18) and (19) give:

$$\cos v = 400\sqrt{5}/5731.4 \qquad v = 81°01.31'$$

$$T = 128.12 \sin 2°59.56' = 6.6890° = 6°41.34'$$

Using ten chords, $s_1 = 40$. Formulas (20) and (21) give the logarithms of k^2, P and Q, from which

$$P = 0.06701 \qquad Q = (6)36$$

Roughly, $27/10P = 270/7 = 40$. As 6^2 is less than 40, formula (23) may be used up to $m = 6$, included:

$\theta_1 = P = .067° = 4'$ $\qquad \theta_4 = .067° \times 16 = 1°04.3'$

$\theta_2 = .067° \times 4 = 16.1'$ $\qquad \theta_5 = .067° \times 25 = 1°40.5'$

$\theta_3 = .067° \times 9 = 36.2'$ $\qquad \theta_6 = .067° \times 36 = 2°24.7'$

By (22) and the table (log P has been already found):

$$\theta_7 = \frac{.06701}{\sqrt{.00041649 + 36}} = 3.282° = 3°16.9'$$

$$\theta_8 = \frac{.06701}{\sqrt{.00024414 + 36}} = 4.285° = 4°17.1'$$

$$\theta_9 = \frac{06701}{\sqrt{.00015242 + 36}} = 5.420° = 5°25.2'$$

$$\theta_{10} = \frac{.06701}{\sqrt{.00010000 + 36}} = 6.6890° = 6°41.34' = T$$

Also,

$C = 3R \sin 2T = 1719.42 \sin 13°22.7' = 397.85$

$X = C \cos T = C \cos 6°41.3' = 395.14$

$Y = C \sin T = C \sin 6°41.3' = 46.34$

$a = X - R \sin 3T = 395.14 - 573.14 \sin 20°04' = 198.49$

$b = Y + R \cos 3T = 46.34 + 573.14 \cos 20°04' = 584.71$

$h = b - R = 584.71 - 573.14 = 11.57$

$OP = (C/\sin 3T) \sin 2T = (C/\sin 20°04') \sin 13°22.7' = 268.29$

$PN = (C/\sin 3T) \sin T = (C/\sin 20°04') \sin 6°41.3' = 135.04$

As a rough check, useful for detecting large errors, (16) gives

$S = \sqrt{24 \times 11.6 \times 573} = 399$ (True $S = 400$.)

An exact check is afforded by (14) and (15).

In the Crandall spiral, the work of computing the constants is somewhat simpler than in the lemniscate. After that, for the same degree of precision, the calculation of the deflection angles involves somewhat more work than in the lemniscate; and, after that, the coördinates must be determined by very cumbrous series. Of course, the lemniscate, like the spiral, lends itself to many short cuts; but these cannot be given here. It may be remarked, in passing, that short cuts, formulas with tabulated corrections, etc., often prove more confusing than helpful.

For the *measurement* (not for the *precise calculation*) of intermediate chords, the formula given below is useful. Let c' be the chord from point ms_1 to point $(m + p)\ s_1$, and $\Delta\theta$ (degrees) the angle at the origin, or $\theta_{mp} - \theta_m$. Then,

$$c' = s_1 p - s_1 p \times 0.00011(\Delta\theta)^2 \qquad (24)$$

This formula is of wide applicability, but space does not permit the discussion of it here. Even for long chords—a purpose for which it is not intended—it gives very close results up to a high limit. Thus, if applied to the long chord in the preceding example, the result is

$c'\ (=C) = 400 - 400 \times .00011 \times 6.69^2 = 397.94$

(Error = .09 ft.)

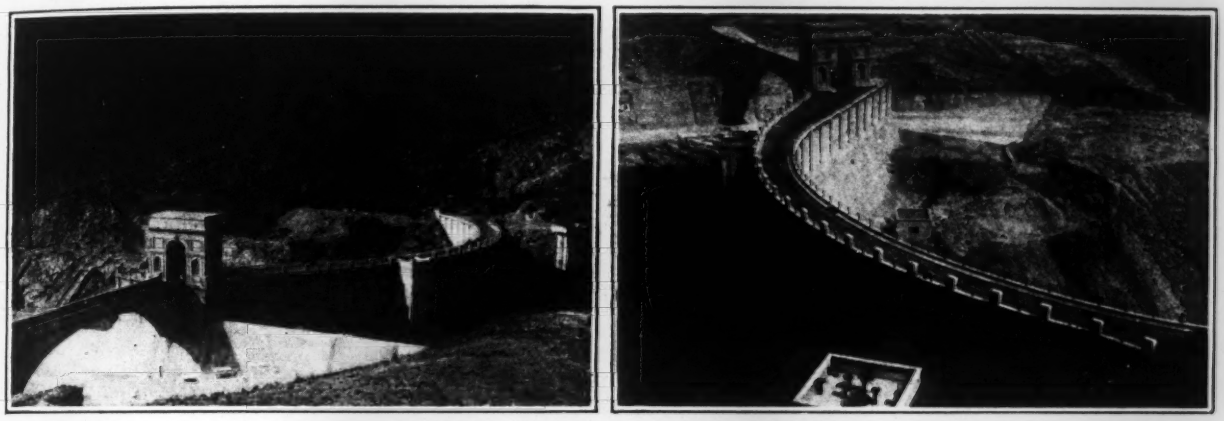
30,553 Miles Federal-Aid Roads Completed

Completed federal-aid roads now total 30,533 miles, according to the Bureau of Public Roads. Of this mileage, 7,236 miles have been completed during the present fiscal year, which began June 30, 1923. The construction season now under way in most states finds 16,652 miles of federal-aid road under construction and 2,602 miles involved in projects which have been approved for construction, much of which will be put under construction during the season. Plans for new projects are coming in from the states in greater volume than for the spring months of 1923.

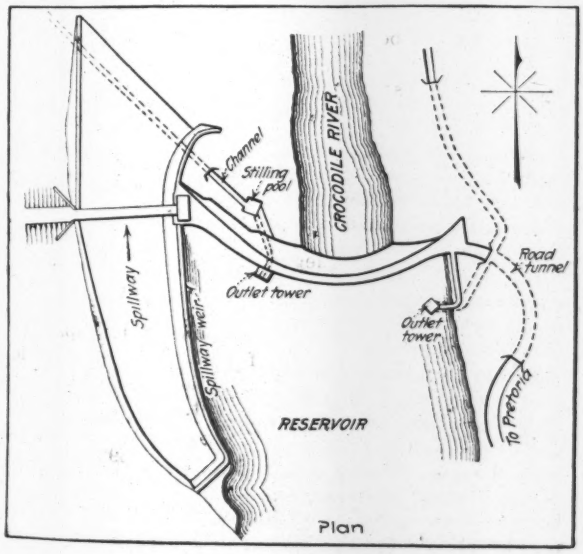
Hartebeestpoort Irrigation Dam in South Africa

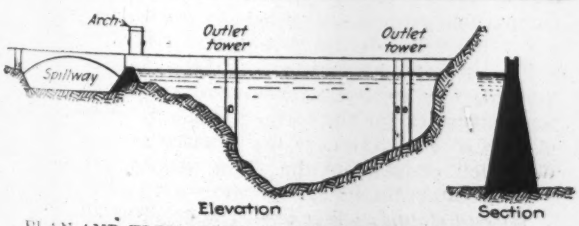
Concrete Arch Dam 195 Ft. High—One End in Hill and Other End at Abutment—Day Labor for Unemployment Relief

AN IMPORTANT irrigation project in South Africa approached its final stages with the completion of the Hartebeestpoort dam on the Crocodile River in September, 1923. This dam is about 23 miles from Pretoria, where the river runs north through the "poort" or gap in the Magaliesberg range. The crest is at El. 3,990 ft. The dam is of concrete, 195 ft. high from the lowest foundation level to the top of the solid parapet wall. It is arched in plan, with a top radius of 240 ft. on the upstream face through an angle of 73 deg. At the bottom (El. 3,795) the radius is 148 ft. and 75 ft. on the upstream and downstream faces, giving a thickness of 73 ft. Both faces have a batter of 1 in 5.714 to El. 3,960, above which they are vertical, giving a thickness of 15 ft. with a roadway along the top. The height of the dam from river-bed level to the crest of the waste weir is 140 ft.; to approximate high-flood level, 158 ft.; to the top of the parapet, 163 ft. From the outlet sill to the waste weir crest the height is 58 ft. The overall height is 195 ft., as already stated.



HARTEBEESTPORT DAM, CROCODILE RIVER, SOUTH AFRICA
Left: view of dam from spillway and bridge end, from left bank. Right: view from right bank.





PLAN AND ELEVATION OF HARTEBEESTPOORT DAM

A flat slope on the west side of the gap necessitated a long tangent abutment, beyond which is the spillway, cut in the rock and separated from the reservoir by a levee or weir 420 ft. long. At its upper end (El. 3,953) the spillway is 56 ft. wide. It has a slope of 5 per cent to the dam, where it is 125 ft. wide and is spanned by a concrete arch bridge. The channel is lined with concrete; beyond its lower end, below the dam, the rock surface of the cliff is faced with gunite.

On each side is an outlet with sill level at El. 3,909. For the east outlet, with a capacity of 300 sec.-ft., there is a tunnel and the flow is controlled by 30-in. gates in a gate tower. The west outlet, with a capacity of 150 sec.-ft., is led through the dam by a 5-ft. opening lined with cast-iron pipe. This leads to a short canal beyond which is a tunnel under the spillway. At the upstream end of this west outlet is an emergency roller gate in a tower built against the dam and at the downstream end the outlet divides into two 24-in. and one 30-in. pipe fitted with valves and discharging into a stilling chamber at the head of the open canal. A small hydro-electric plant will supply current for lighting and pumping near the dam. The main road from Pretoria to Rustenberg has been diverted to cross the dam. This involved a rock tunnel approach on the east side. A monumental concrete arch spans this road at the west end of the dam and supplies some of the extra weight required for the abutment.

Construction was started in 1920 but was prosecuted more rapidly after that year in order to furnish employment for white labor, work then progressing so rapidly that the floods of the 1922-23 season were impounded.

The reservoir has a drainage area of 1,560 square miles with an average annual rainfall of 26.34 in. Its surface area is about 6.7 square miles and its gross

storage capacity is 136,241 acre-ft. at spillway level or 123,232 acre-ft. above outlet level. This capacity can be increased by placing movable gates on the spillway weir. Rights have been acquired for storage to El. 3,985, giving a surface area of 9.2 square miles. The law prohibits any other storage works in this drainage area and requires that 600,000,000 cu.ft. annually must be passed as compensation to landowners below the dam.

This project has been carried out under the Irrigation Department of the Union of South Africa, of which A. D. Lewis is director. The chief engineer of construction is J. L. Hill; successive resident engineers since 1918 have been G. T. Ritchie, W. Cooper, F. W. Scott and B. G. Twycross. Information for the above article is taken from a pamphlet issued by the Irrigation Department.

Spot-Welded Girders and Columns Tested for Strength

Welded Plate Girders Found As Strong as Riveted But More Flexible—Welded Columns Weaker Than Riveted

By Dr. L. B. Tuckerman
Engineer-Physicist, Bureau of Standards, Washington

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COMPARATIVE strength tests of spot-welded and riveted members to determine the relative efficiency of the two methods of joining were carried out at the Burau of Standards a short time ago for the American Bridge Co.

Forty-two tensile specimens, six girders and six columns, representing equal numbers of similarly made riveted and welded members, were submitted by the company for test. The following is a brief statement of the results:

Two kinds of spot-weld were included. The *button* type (Fig. 1) was used for all specimens with the exception of one girder; on this the *embossed* type of weld was used. In the former type of weld one electrode (or, in the case of the heavier members, both electrodes) formed the electrical contact with the work through 2-in. copper discs ⅛ in. thick. In the embossed type a circular area about ⅞ in. in diameter on both surfaces of one of the plates of the specimen was raised at the point of weld by special dies which forced the metal toward the center and raised it above the surface. In making both types of welds the usual precautions in spot-welding practice prevailed. The clamping force exerted by the electrodes was estimated at approximately 8 to 10 tons.

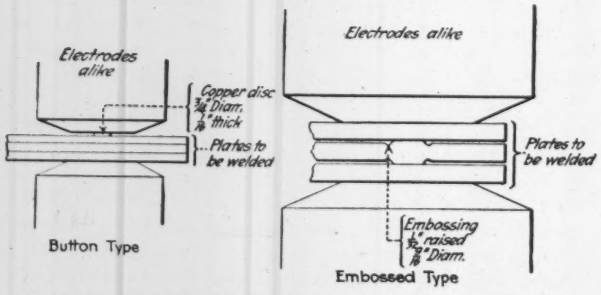


FIG. 1—TWO METHODS OF WELDING REPRESENTED IN THE TESTS

Usual shop-riveting practice prevailed in fabricating the riveted specimens. The ⅝-in. diameter rivets used were somewhat smaller than the spot-welds on the

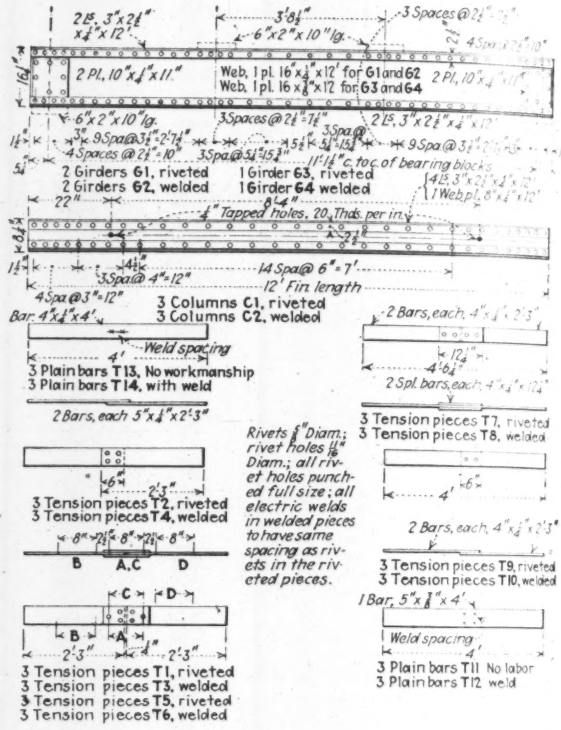

2 Pl, 10"x¼"x11"
Web, 1 pl. 16"x¼"x12' for G1 and G2
Web, 1 pl. 16"x⅜"x12 for G3 and G4
2 Girders G1, riveted
2 Girders G2, welded
1 Girder G3, riveted
1 Girder G4 welded
4 Tapped holes, 20 Thds. per in.
3 Columns C1, riveted
3 Columns C2, welded
Weld spacing
3 Plain bars T13, No workmanship
3 Plain bars T14, with weld
2 Bars, each 5"x¼"x2'3"
3 Tension pieces T2, riveted
3 Tension pieces T4, welded
3 Tension pieces T1, riveted
3 Tension pieces T3, welded
3 Tension pieces T5, riveted
3 Tension pieces T6, welded
Rivets ⅝" Diam.; rivet holes 11/16" Diam.; all rivet holes punched full size; all electric welds in welded pieces to have same spacing as rivets in the riveted pieces.
2 Bars, each 4"x¼"x2'3"
2 Spl. bars, each 4"x¼"x12"
3 Tension pieces T7, riveted
3 Tension pieces T8, welded
2 Bars, each 4"x¼"x2'3"
3 Tension pieces T9, riveted
3 Tension pieces T10, welded
1 Bar, 5"x⅜"x4'
Weld spacing
3 Plain bars T11 No labor
3 Plain bars T12 weld

FIG. 2—SPECIMENS AND MEMBERS TESTED

corresponding welded specimens. The test specimens themselves are sketched in Fig. 2.

Tension Specimens—The welded joints tested in tension had a higher ultimate strength than the riveted joints; the average ratio was 1.15. The yield-point ratio for the two types of joints averaged 1.26. The average ratio of the yield points of the joints to that of the plain portion of the plates was 0.68 for the riveted joints and 0.80 for welded.

No specific tests for brittleness were made. The tensile specimens indicated somewhat lower elongation in the neighborhood of the welds, but no marked brittleness was observed.

Girders of Equal Strength—In the girder tests the load was applied at two symmetrically located points in the free span of the specimen. There was no appreciable difference in strength between the riveted and welded types. Values obtained for the ultimate strength of the riveted girders were 86,000 lb. and 93,000 lb. as compared to values of 88,200 lb. for the embossed-weld and 89,400 lb. for the button-weld girders. Two other comparable girders withstood 104,700 lb. for the riveted, and 106,900 lb. for the button-type welded girder.

The welded girders were more flexible than the riveted, the apparent modulus of elasticity being 5½ per cent lower for the former. This difference is shown clearly in Fig. 3, where the greater slope of the load-deflection curves for the three welded girders shows their greater flexibility.

Welded Columns Weaker—The columns all had an *l/r*

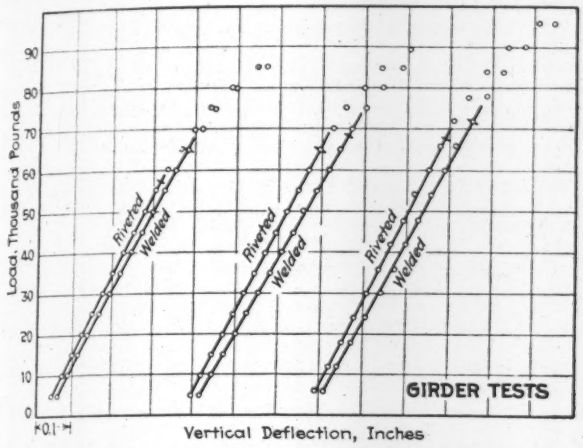


FIG. 3—LOAD-DEFLECTION DIAGRAMS FOR GIRDERS

ratio of 121 and were tested with flat ends. The riveted columns developed an average strength of 31,630 lb. per square inch, while the welded columns averaged only 27,500 lb. per square inch. The greatest deviation of any single test from the mean for the three columns was 2.5 per cent for the riveted and 3 per cent for the welded columns.

These columns lie in the transition region of slenderness ratio, where the behavior of columns depends upon a number of factors. The l/r ratio, the apparent modulus in bending, the yield point, the end fixation and the load eccentricity all affect the ultimate strength of the member. Coupon tests showed no appreciable difference in the yield-point of the material, the averages being 39,420 for the welded columns and 38,540 for the riveted. A study of the load-compression curves (Fig. 4) shows no consistent difference attributable to end conditions or eccentricity of the columns. Because of the evidence of a 6 per cent consistent difference in the apparent modulus found in the girders, the difference of 13 per cent in the ultimate strength of the columns could possibly have been due to their greater flexibility. Before definite conclusions can be drawn, however, further tests at different slenderness ratios would be necessary.

In neither the girder nor the column tests was there any indication of failure of individual welds until long after the maximum load had been passed and large permanent deformations had been produced. Under these circumstances some of the welds opened up near the points of greatest deformation.

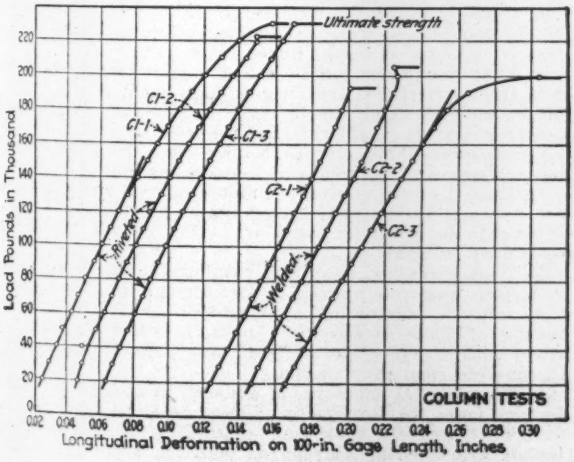


FIG. 4—LOAD-COMPRESSION CURVES FOR COLUMNS

Conclusion—As the strength of these welded and riveted members did not differ greatly, it is possible that spot welding may successfully replace riveting for structures fabricated from rolled steel, provided the cost of welding is not prohibitive. Further tests should be sufficiently extensive to cover a wide range in dimensions and should be planned to make the effect of the strength and rigidity of the connections as great as possible. In addition, tests should be made to determine whether spot welds have a satisfactory fatigue resistance.

Action of Frost on Alumina Cement

STUDIES of the action of frost on alumina cement or "ciment fondu" have been carried on in England and on the Continent during the past winter, according to *Engineering*, London. From these tests it has been found that an increase of temperature from the normal, which was taken as 64 deg. F., up to 85 deg., tends to retard the actual setting time of alumina cement, while a reduction from the normal to any temperature down to 32 deg. does not appear to have any influence on this characteristic. As regards hardening, cubes made at normal temperature and maintained thereafter for 24 hr., and subsequently at a temperature of 32 deg., show results at different ages equal to those kept throughout at normal temperature. On the other hand, cubes mixed in the open air at 32 deg. F. and subsequently immersed in water at 32 deg. for 24 hr. show a very slight loss compared with the resistance of samples made and kept under normal conditions.

As the setting of alumina cement is accompanied by the early production of a considerable amount of heat, advantage can be taken of this effect during cold weather, since if the concrete is mixed and can be maintained for the first four or five hours at a temperature above 32 deg. F., hardening will follow its normal course as the heat produced will counteract the effect of a fall of external temperature. This contrast with portland cement in which the time taken in hardening is so long that freezing may occur before stable conditions have been reached, and the delay in the generation of internal heat makes this of little assistance in these circumstances. According to the tests, portland cement concrete does not reach its highest temperature until from three to six days, instead of in a few hours as in the case of alumina cement.

Further experiments have been made on the use of chemicals such as calcium chloride or salt to lower the freezing point of the mixture as is done with portland cement. Such agents are not recommended for alumina cement, the setting of which is retarded to such an extent by such chemicals that in the early days the strength is very low.

Siam to Change Rail Gage

The Railway Gage Problem has been encountered in Siam, with the result that the Northeastern line is to be converted from 4 ft. 8½ in. to meter gage. A third rail has been laid on part of the line to permit through traffic.

Wear of Concrete Pavements Tested at Arlington

Accelerated Tests By Bureau of Public Roads Show (1) No Wear From Rubber-Tired Wheels; (2) No Strength-Wear Relation

Extract from report of Bureau of Public Roads prepared by F. H. Jackson and J. T. Pauls, and published in "Public Roads" for May, 1924.

THE ACCELERATED wear tests of concrete pavements conducted by the Bureau of Public Roads, at Arlington, Va., during the past eighteen months have reached the stage where it is possible to draw fairly definite conclusions from the data so far obtained. The 62 concrete test sections, each 4 ft. wide by about 10 ft. long, and constructed in the form of a circle approximately 625 ft. in circumference, have been subjected to approximately 300,000 passages of a solid-rubber-tired truck wheel loaded to 3,000 lb. and traveling around the circle over the same path at a speed of 22 miles per hour. Careful observations of the lateral distribution of traffic across actual pavements indicate that about 10 per cent of the total passes over a 6-in. width at the point of greatest concentration. This is based on traffic passing in two directions over an 18-ft. road. On this basis it is estimated that the experimental pavement sections have been subjected to a traffic equivalent to about 1,500,000, two-ton trucks operating at a speed of 22 miles per hour assuming the distribution indicated by the above observations. In addition, the test sections have been subjected to about 50,000 passages of a rubber-tired wheel loaded with the same weight and equipped with non-skid chains and the same number of passages of a plain-rubber-tired wheel. The wheels in this part of the test traveled over a new path. It will be seen, therefore, that the equivalent of an enormous volume of traffic has been put upon the pavement—an amount equivalent to several years' traffic on an average road.

It was, of course, impossible to reproduce on the test sections in the short space of a year and a half the effect of freezing and thawing which, through a period of years, may weaken actual roads so that they become less resistant to traffic. It was likewise impossible to reproduce the effect of differential expansion and contraction of the thin, rich mortar top and the mass of the concrete, which, caused by wide variations in temperature, may also, in time, lower the resistance of a pavement. The essential time element is lacking. In these respects, therefore, the test did not duplicate actual conditions.

Purpose—The primary object of the test was to determine what relations, if any, exist between the surface behavior of concrete roads under traffic and the various laboratory tests for quality of the aggregates. Incidentally it was also deemed desirable to determine the relation between the wear as produced by traffic, as well as by laboratory test, and the various physical properties of the concrete, such as crushing strength, transverse strength, modulus of elasticity and absorption. All of these tests were made on the concrete used in each of the 62 tests sections.

Specifications for aggregates for concrete pavements are usually drawn to cover the gradation and the quality of the material furnished. The gradation, or proportion of the various sizes, especially as regards aggregates which are crushed and screened, depends largely on factors which can be controlled, so that the engineer may obtain almost any desired gradation of sizes provided he is willing to insist upon it. The quality of the material, however, cannot be fixed in so arbitrary a fashion. Due to the high cost of transportation, the aggregates for any given improvement must generally be found within a relatively short distance of the site of the work. Therefore, as the quality and character of materials vary so greatly in different parts of the country, it follows that many different kinds and types of aggregates must be employed in the construction of concrete roads. All that can be done is to draw specifications in such a way as to insure the use of the best material available for the work. In so doing, however, there is a minimum limit beyond which it is unsafe to go.

What are the safe test limits for the various kinds of aggregate used in concrete road construction? Do the present limits for wear, strength, etc., insure the selection of safe materials, or, on the other hand, do they unduly add to the cost of construction by setting laboratory requirements too high? These are some of the questions which the accelerated wear tests were designed to answer.

Premises—Before attempting to draw general conclusions from these tests, it may be well to restate certain premises as to volume and character of traffic. These premises follow:

1. That on the average 18-ft. concrete road, approximately 10 per cent of the total traffic moving in both directions passes over a band 6 in. in width at the point of maximum concentration. Therefore, the traffic passing over the test road should be multiplied by at least 10 to get the equivalent volume of traffic on an actual pavement.

2. That the comparative resistance of each test section to the surface wear produced by the tire chains is an indication of the comparative resistance which would be offered by the concrete to wear or disintegration at the edges of exposed joints and cracks under service conditions.

3. That conditions which cause surface wear, such as steel tires, tire chains tracking through snow, etc., are present to such an extent as to make it necessary to give the question of wear consideration in the selection of aggregates.

Conclusions—The authors believe that the data so far secured warrant the following conclusions:

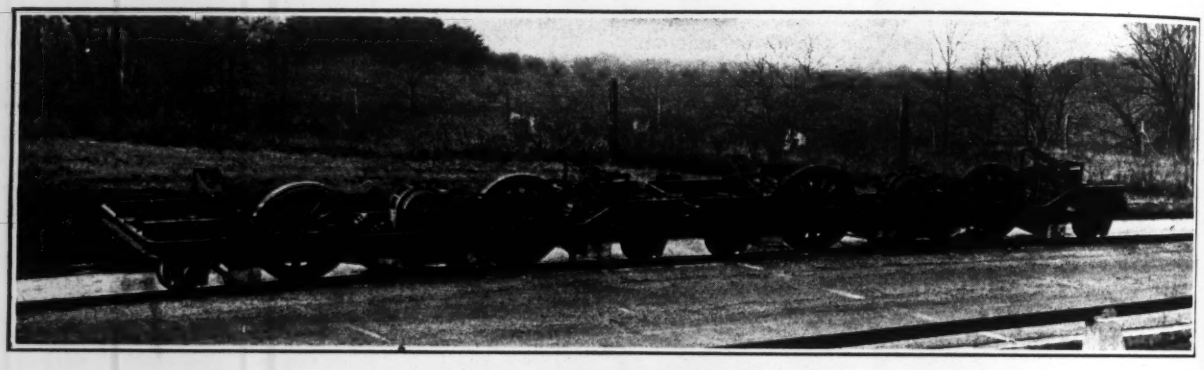
1. That the rate of wear of stone concrete is, in general, not affected by the coarse aggregate, provided the coarse aggregate is equal or superior to the mortar matrix in resistance to wear.

2. That excessive wear will result from the use of very soft stone as coarse aggregate even though used in conjunction with a mortar of satisfactory quality. From the results of these comparative tests, it would appear that stone with a percentage of wear over 7 should not be used in concrete road construction.

3. That gravel concrete, in general, is at least as satisfactory from the standpoint of wear as stone concrete.

4. That gravels consisting essentially of siliceous materials are superior as regards both the amount and uniformity of wear to those containing a preponderance of calcareous fragments.

5. That gravels consisting of rounded particles are as



DEVICE FOR TESTING WEAR OF PAVEMENTS

satisfactory from the standpoint of wear as those consisting wholly or in part of angular or crushed fragments.

6. That small amounts of shale occurring in the coarse aggregate will cause both excessive and uneven wear.

7. That the modified abrasion test for gravel in its present form is not an indication of the wear-resisting properties of coarse aggregates. It is suggested that if the severe impact action of the steel balls were decreased, much more pronounced results would be secured.

8. That blast furnace slags should prove satisfactory for use in concrete pavements provided the proportion of light, porous slag is so controlled that the weight per cubic foot will be at least 70 lb.

9. That the presence of large amounts of light, porous fragments in blast furnace slag will cause excessive wear.

10. That somewhat better results are secured by the use of the smaller sizes of slag.

11. That slag or stone screenings are, in general, unsatisfactory as substitutes for natural sand as fine aggregates in concrete road construction.

12. That the copper and lead smelter slags used in these tests would be satisfactory aggregate with regard to wear.

13. That coarse sands, other things being equal, show greater resistance to wear than fine sands.

14. That the so-called "tensile-strength-ratio" test is no indication of the wear-resisting properties of concrete made with these sands.

15. That the Talbot-Jones wear test is not, in general, an indication of the wear which takes place under traffic.

16. That neither the crushing nor the transverse strength of concrete is a measure of its wear-resisting properties.

17. That the addition of hydrated lime in the proportion used in these tests does not affect the wear-resisting properties of concrete.

18. That so far as resistance to wear alone is concerned, increasing the cement content beyond a cement-sand ratio of 1:2 does not materially affect the concrete. Leaner mixes on the other hand show marked increase in wear.

19. That unusual precautions should be taken in using mine ohats or other similar harsh-working materials, so as to increase workability to a maximum and thus make possible a smoother surface finish.

20. That, other things being equal, either an excessively dry or an excessively wet mix will show less resistance to wear than concrete of medium consistency.

Practicable Loads on Water Purification Plants and Processes

By Wellington Donaldson
Of Fuller & McClintock, Consulting Engineers, New York City

Abstract of a contribution to the work of the Committee on Practicable Loadings of Purification Processes, prepared under the direction of the Standardization Council of the American Water Works Association. The full report will appear in "Journal" A.W.W.A., July 1924.

A PURIFICATION plant or any part of it is overloaded if it is unable to deliver a satisfactory quality of water, at the required rate of operation.

It is the committee's belief that the application of the Treasury [U.S.P.H.] standard necessitates for the majority of representative American water supplies the use of chlorination in addition to the other processes. If the standard itself is a valid and proper one, it follows then that chlorination must be accepted as a legitimate step and not merely as a factor of safety. For example, the Cincinnati plant would have to be considered overloaded at times, if chlorination has no legitimate function except as a factor of safety. The logical implication then is that Cincinnati, although at present operating filters at only about 70 per cent designed capacity, should undertake considerable plant extension to provide double coagulation, double filtration or some other means of materially increasing efficiency during occasional periods of high bacterial loading. The suggestion hardly seems reasonable in view of the equivalent result to be obtained by the use of chlorination at times, and the comparative costs.

Chlorination is a legitimate step in purification where the added cost, due to the increased amount of chemicals necessary to produce an effluent of given purity, exceeds the cost of the chlorine necessary to produce the same quality of effluent. Where constant laboratory supervision is maintained, the above is certainly true, while in the smaller plants where samples are taken only once a week, it may be fair to consider chlorination as only a factor of safety.

The rate at which water may be passed through a given basin or a filter is closely related to the impurities present in the water. In other words, the rate is only one of the factors determining "overload." For example, rapid sand filters have customarily been designed in this country on the basis of 125 m.g.d. per acre, following the precedent established by the Louisville experiments in 1898. The new Detroit filters, however, were designed for 160 m.g.d. per acre after local experimentation had shown that a rate of 200 m.g.d. might be used without detrimental results. Obviously there are certain limitations as to performance of any particular step in the purification process and the committee presents below certain tentative limitations for purposes of discussion, realizing it has not in its hands sufficient data to show that these limitations may not be exceeded without detrimental results.

Coagulating basins—(*a*) Coagulating basins without filters will be considered overloaded when they produce a water with turbidity over 10 and color over 10, with disagreeable taste and odor. (*b*) Basins followed by filters will be overloaded when they deliver a water with turbidity over 40 and in such coagulated condition as to result by filtration in an effluent with appreciable turbidity and with color over 10. No limitations of bacteria are included above, because bacterial reduction is incidental to the main functions of basins as stated.

Rapid Sand Filters—Filters will be considered overloaded if (a) they fail to deliver a clear effluent with an applied water having turbidity of 40 p.p.m. or less for a period of eight hours, (b) if they fail to deliver an effluent having a color of less than 10 p.p.m. after proper coagulation, (c) if they fail to deliver an effluent which after chlorination will not conform to accepted standards of bacterial purity. The above limitations assume an applied water correctly treated with coagulant. The eight-hour period is specified as being the minimum practical length of filter run which will allow the plant to be washed continuously. Disregarding odors and tastes, the eight-hour period is a measure or limit of "overload" due to algae and other micro-organisms.

Chlorination—Chlorination is overloaded if the treated water fails to conform to accepted standards for bacterial purity or if its use produces objectionable odors and tastes in the supply.

Secondary Coagulation—Secondary doses of coagulant may be used for the following purposes: (*a*) to correct faulty primary treatment caused by accidental interruption or other under-treatment; (*b*) to remove the end products of softening with lime or soda ash in order to reduce sand incrustation and lime accretions. Coagulant so used has a certain value in the way of recarbonation; (*c*) to supply an adequate mat to filter beds when primary coagulation and sedimentation give too clear an applied water; (*d*) as a "split feed" where, for reasons of economy or improved results, separate applications of coagulant are made to different points rather than a single larger dose at one point.

Allowable Loads on Wooden Columns Reduced

In the new specifications for timber bridges of the U. S. Bureau of Public Roads the loads on wooden columns are reduced from those allowed under the 1919 specification of the bureau. The formula formerly used was 1200—20L/D. The new formula makes the reduction factor 25L/D. The new formula provides a factor of safety approximating 2 on the basis of the column test made at the Forest Products Laboratory, while with the former formula the factor of safety in some cases went as low as 1.5. The tests of large columns (12x12 in.x24 ft.) at the Forest Products Laboratory are not yet all completed, and it is possible that the further tests may result in additional modification of permissible stresses.

Helping the Young Engineer to Deal With Men

Story of the Industrial Service Movement Whereby College Students Can Gain an Insight Into Human Relationships

By Fred H. Rindge, Jr.
Secretary, Industrial Service Movement, International Committee Y. M. C. A., New York City

INCREASINGLY, leaders in industry and business will be drawn from the graduates of engineering and commercial courses. What type of industrial leaders will they be? If they are to be men of vision, able to cope with the great problems of the day, and to deal intelligently with all types of people, there must be a definite program to this end in our engineering schools. If these engineers are to improve industrial conditions they must be given more opportunity to understand industrial conditions; and if they are to help avoid labor difficulties they must appreciate the point of view of laboring men before they graduate from college.

Can our coming leaders of industry learn this proper attitude toward the men they will have to direct before they leave college? On first thought we might say that they must get out into the practical world and rub elbows with the workingmen before any such appreciation can come. On further consideration, however, it is evident that these young men may "rub elbows" before graduation, by teaching English and American citizenship to classes of foreigners, by leading clubs of factory apprentices, by helping American workingmen in technical aspects of their daily work—mathematics, mechanics, mechanical drawing, blueprint reading, etc. As they go into foreign homes and boarding houses, into shops and labor unions, mines and quarries, they will understand existing conditions. Such experiences make an indelible impression and lead to new visions of responsibility and service.

The Industrial Service Movement—This idea started at Yale fifteen years ago, and has spread to 250 other colleges and engineering schools. Experience of this nature has reacted on those who served, and this reaction has in the years following graduation led these college men into far greater service. It seems surprising that 5,000 students are engaged in volunteer leadership at the present time. They are helping 100,000 workingmen and boys, without financial compensation. Considerable machinery is naturally required to find opportunities, organize classes, enlist and train leaders and keep them enthused and efficient. This machinery has been provided by city and college Young Men's Christian Associations throughout the country, and the whole movement has been supervised by state and international committees of this organization.

Have engineering graduates shown any effects of such training in the human side of engineering? So far as observation goes we can answer positively in the affirmative. Already many companies have shown a disposition to hire engineering graduates who have had experience with workingmen. One such graduate proved so efficient in dealing with foreign employees that his company asked him to develop a system of education, which resulted in 2,000 employees studying English in the plant. This young man testifies that he "learned how at college" and owes his job to that experience. Others have, in a surprisingly short time, become active in safety and health promotion and in many lines of industrial betterment. No one can measure the changed attitude, the finer spirit, the sympathetic dealing with employees and the democratic actions and co-operation which have ensued in many cases.

The volunteer leader of a good citizenship club says, "I never understood workingmen until I started this work. The men have done me more good than I could ever do them. I have become good friends with many of them and have had opportunity for a real personal influence." We recall a prominent football player who, soon after graduation, became interested in this kind of service. In considering the human side of his job he was faced with responsibility toward his foreign employees. Though he was general superintendent of the works, he was not too "big" to teach his foreigners English several nights per week in his own office. He writes, "The satisfaction and pleasure are sufficient to make me feel selfish, and I know it is also an asset for the men. I can honestly say that this friendly basis helps, rather than hurts, discipline. I cannot see the wisdom of unwillingness to stand shoulder to shoulder with anyone, foreigner or otherwise. I try to lead by example."

There is a great difference between the man who caught the vision in student days and one who did not. Recently an employer said, "We don't want any of your educational work, our employees know too much already." He was a college graduate, but thoroughly unsympathetic. Soon after in another large plant we made a similar proposal of co-operation, and the general manager replied "It's up to our efficiency man. He has full charge of that sort of work. What he says goes." We met Mr. Efficiency Man. In less than three minutes he said, "Good! I know all about your proposition because I helped organize that work in student days. In my senior year I met with a bunch of workingmen every week, tried to help them and to learn from them all I could. That was the most valuable experience I had in college. I've been planning a scheme of service and education for our employees and you've come at just the right time."

This movement has broken down barriers, removed prejudices, changed lives, and is sending men out of college into positions of influence with a new vision, a new sympathy, an intelligent understanding, a determination to help solve some of the world's great industrial and social problems.

Teaching Service—It therefore seems wise for college professors and business men to encourage such activities of both students and graduates. An increasing number of universities and technical schools are including in their curricula regular courses on the human side of engineering and business. Would it not be well also for every engineering school to have special reference libraries dealing with the same subjects? Why not a bulletin board on which would be posted the latest material on industrial betterment? When students make their inspection trips, how much attention is given to the human side? We talked recently with a group of students who had visited a great industry, noted

throughout the country for its successful accident prevention, fair treatment of employees, ideal working conditions and shop councils. Not a single student had learned anything about these things during the entire trip. All of their attention had been given to machinery and technical methods and they had utterly ignored the great personnel problems.

Many college students frequently hear lectures on "human relations" or meet together in weekly discussion groups under competent leadership. Their study of industrial questions is supplemented by observation trips and practical service. Several universities have held congresses on human relationships, during which the interest of the entire student body has been concentrated on the human side of their chosen profession. Surely these are significant steps in the right direction.

Carbon Monoxide in Gas Heaters Due to Incomplete Combustion

IN A full-scale experimental study of domestic gas heaters, the U. S. Bureau of Mines recently found dangerous production of carbon monoxide under certain conditions, even with widely used types of heater. The tests were carried out exclusively with natural gas, but in the opinion of the Bureau the results hold also for artificial gas. In each test a heater was placed in a tightly closed room of 1,000 cu.ft. capacity, and was operated under fixed gas-flow conditions until the flame was extinguished by the exhaustion of oxygen in the room. In the worst run, the final carbon monoxide percentage was 1.72, whereas one-eighth to one-tenth this amount is quickly fatal and even one-thirtieth as much will cause harmful effects upon 1-hr. exposure. The principal cause of carbon monoxide generation in these heaters was insufficient air supply for complete combustion, due either to the construction of the heater, or to so high a rate of gas consumption that the heater could not supply enough air, or to disturbed combustion occurring when the flames impinged on the heater surfaces.

A heater which carried a number of small jets supplied by gas without primary air admixture produced no carbon monoxide when the flames were in normal position, clear of the metal guard or reflector, but produced considerable carbon monoxide when the burner tips were turned so as to allow the ends of the flame to strike the reflector. A heater of the blue-flame type having a perforated metal hood surrounding the burners produced carbon monoxide when the gas flow was made so large that the flames burned through the holes of the hood. An asbestos-back heater produced small quantities of carbon monoxide when used without a metal-and-mica front shield, and dangerously large quantities of carbon monoxide when such a shield was attached. In general, carbon monoxide production was found to be probable in all types of heater which have metal surfaces coming in contact with the flame either normally or occasionally. Aldehyde odors, or "gas fumes," were usually produced under the same conditions that produced carbon monoxide, and while these odors are not a sure guide, they may be taken as an index of carbon monoxide production. The tests are reported in detail in Technical Paper 337 of the Bureau of Mines.

Explosion in a Concrete Building Under Construction

AN ATTEMPT to wreck the reinforced-concrete building now being built at Cincinnati, Ohio, for the Cincinnati Terminal Warehouse Co. was made on the evening of March 21. An official report states that a charge, probably of dynamite, had been exploded beside a column just above the fourth floor of the cold-storage section, with results shown in the accompanying view. The concrete outside the column spiral was stripped off, a large hole was made in the floor and the cap of the column below was blown off. The concrete

EFFECT OF DYNAMITE ON CONCRETE COLUMN
Square columns used in certain parts of building.

within the column spiral was uninjured and the green concrete above showed no injury except a hair crack in the sixth floor slab, which had been poured the day before the explosion. The injured concrete has been removed and it is expected that the work can be restored so as to be as strong as before.

At the time of the explosion, the fourth floor was fifty days old, the fifth floor twenty-one days and the sixth floor thirty-six hours old. The weather had been below freezing a large part of the time. All the floors were heated for about four days after pouring. The fourth floor had not reached its full strength. The fifth floor was shored. The shores were blown out for several bays near the explosion. Although this floor was only three weeks old and was carrying the green sixth floor, no damage could be detected. The building was designed by A. M. Allen & Co., architects and engineers, Cleveland, Ohio; the Ferro Concrete Construction Co., Cincinnati, has the general contract.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Against Licensing

An Open Letter to the Joint Committee on Structural Safety

Gentlemen:—By and with the advice and consent of the chairman on the part of the civil engineers on the Joint Committee on Structural Safety, this by it invited criticism of the report (printed in abstract in *Engineering News-Record* of April 10, p. 615) has taken the form of an open letter. It should lead to discussion of the report at any distance from the meeting place of the committee, for its subject matter is truly of national importance. And, though aiming apparently at a New York State law only, it is liable to be copied and enacted in any or all of the states of the Union.

In the draft of a law embodying suggested requirements, the "designer" is spoken of as a "registered architect, or licensed professional engineer." This apparently assumes that we shall always have with us, in those of the United States that now "license" engineers, thus designated engineers; and in those states that have them not, that this species of engineers shall and will be created.

"'Tis a consummation devoutly to be" negatived and discouraged in the minds of men, especially in that of the average legislator.

It has been computed that if an engineer took out a license in only the twenty-odd states that now have engineer license laws, so that he could respond quickly to a call for his services coming unexpectedly from most any state of the Union, as they generally do, it would take six months' time to accomplish it, and it would cost him $700. Some license states extend the privilege of practising in them to an engineer, licensed in any state; more do not.

The spirit of that provision of the constitution of the United States that "the citizens of each state shall be entitled to all privileges and immunities of citizens in the several states" certainly would make such comity between the states obligatory in the present instance, but the ruling to date has been otherwise; and claiming to act under its police power, nearly all the license states demand a license of their own. Uniform legislation among the forty-eight states of the Union, together with the District of Columbia, not to mention the overseas "possessions," is practically unattainable, as has been proven in many instances. And if by any chance such uniformity were ever attained, there is not the slightest guarantee that it would be maintained. On the contrary, there is every reason to believe that it would be speedily destroyed.

But going farther, the hope may be indulged in that the day will come when these state engineer license laws will be replaced by something more rational. The existing laws began as the consequence of petitions conceived by certain office draftsmen in a trade union spirit; and they have been sought in other states in notably the same spirit—one having no proper place in the ranks of a profession; and one such attempt having succeeded in foisting a license law upon the engineers practising, or desiring thereafter to practise, in that one state, the law has been more or less blindly copied in the given number of states of the Union, while in others such legislation has failed of enactment.

The whole system of licensing engineers by the kind of laws so far enacted has not yet been tested as to its constitutionality, and many believe that the laws hitherto enacted are unconstitutional and void. In Pennsylvania a judge in the first instance has already declared the Pennsylvania engineer license law unconstitutional.

And, as I am credibly informed, the state law officer consulted by the New York board of license commissioners has ruled that an engineer's license must be issued to any one applying for it, on his paying the necessary fee. What protection, it may be asked, is there to the public under a law like that; and why should a Report of a Joint Committee on Structural Safety refer, or defer, to such a law?

It is well known that after several years of public discussion, the engineers of Great Britain have been saved from the infliction of a Parliamentary license law; and instead the members of the Institution of Civil Engineers have adopted the system of designating themselves as "chartered civil engineers," the Institution existing, as it does, under royal charter. Similar systems are in force in several of the provinces of the Dominion of Canada.

And in view of all the foregoing, I respectfully urge the honorable committee not to use any designation of a fit and competent engineer that would tend to support or perpetuate the engineer license laws of any of the states of the Union.

What to substitute for the designations used in the joint committee's tentative draft, the committee very likely will itself know best. I suggest the wording "an architect or engineer publicly known to be competent and experienced." If further legislation be advisable or required thereafter, it could prescribe what architects and engineers shall be considered as "publicly known to be competent and experienced."

Engineers are particularly affected by laws emanating from the several states that control their work for a livlihood. Doctors and lawyers seldom leave the community in which they begin to practice. But an engineer is most always in light marching order, ready, even eager, to accept a call for his services from any part of the Union, or from beyond the seas. He should have a *United States* license, if any license be considered proper; or a certificate to practise anywhere, by a national authority. One such exists today, in the vote, after examination of his professional record, which elects him a full member of the American Society of Civil Engineers; and the public throughout the United States would be better protected than they now are, if none but members of that society were authorized to hold out themselves as fit and competent civil engineers. The other national engineering societies could readily adopt the like tests and methods of certification.

The laws of the country, as I understand it, now give a measure of safety to building construction, by making the owner of the bridge or building liable in damages to those injured, and to his heirs for those killed, by his neglect to take proper precautions to make the structure upon or to which he invites the public, safe and secure. But it has been felt and experienced that this is not enough; and the additional safeguard is now desired of making it a crime or a misdemeanor not to take the precaution of employing only skilled designers and workmen in the construction of buildings.

If no statute prescribe who shall be considered "competent and experienced," I presume the burden of proof that he had employed only thus qualified persons would, in case of harm to others, rest upon the owner of the building. And as a protective defense in both a criminal and civil action, this would no doubt be more deterrent than as a prospective defense in a civil action only.

Now all this, and the whole subject, bristles with "these nice sharp quillets of the law." The whole subject is one of law. The committee set out to submit: "that a law should be prepared." My "constructive suggestion" therefore is, that the committee submit their report and this letter to able counsel, for aid in their work of nation-wide bearing and importance.

All of which is respectfully submitted.

New York, May 14. CLEMENS HERSCHEL.

Cast-Iron Pipe Costs

Sir—The chart for finding costs per foot of cast-iron pipe, contributed by James R. McComas and published on p. 370 of your issue of Feb. 28, 1924, is substantially the same as a chart for the purpose which I prepared about ten years ago and published on p. 612 of the *Journal* of the American Water Works Association for 1914.

The essential difference between the two is that Mr. McComas' chart has a higher price range for the pipe on a tonnage basis than mine. In 1914 it was probably not anticipated by anyone, certainly not by me, that the price of pipe would mount to such heights as the World War conditions caused it to do. W. E. MILLER,

Madison, Wis., May 19, 1924. Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Concrete Ties of the Stent type, consisting of two reinforced-concrete blocks connected by tie rods (see *Engineering News-Record*, Sept. 27, 1923, page 511), are now in use on about a hundred miles of the Northwestern Railway, India, and about thirty miles of track are to be laid with these ties during 1924 and 1925.

The Government Railways of China at the end of 1922, had a total length of about 4,190 miles, with 5,200 miles of track. Their equipment aggregated 257 passenger locomotives, 558 freight locomotives, 177 switching locomotives, 1,395 passenger cars, 14,400 freight cars and 366 service cars (inspection, hospital, pay, supply and wrecking cars.)

The Highest Bid Yet Offered on any part of the $87,000,000 municipal bond issue of St. Louis, Mo., was received May 26 on $2,000,000 of 20-year 4½ per cent bonds to be used to provide a revolving fund for street openings and widenings. A total of $2,037,980 or $101.899 each was bid by a syndicate composed of the Mercantile Trust Co. and Liberty General Trust Co., St. Louis, and Blair & Co. and Hellgarten & Co., of New York City. Previously $10,000,000 of bonds had been sold, high bids ranging from $100.48 to $101.17.

Patentees of Public Lands across which power transmission lines have been constructed under authority and regulations of the Secretary of the Interior cannot eject the corporation owning such lines from the land, according to a decision of the U. S. Supreme Court, in an opinion by Justice Butler. The decision upholds the authority of the Secretary of the Interior to make reservations in granting patents to homestead entries. The case was that of the Washington Water Power Co. against John Swendig and others, the decision of the lower courts being affirmed.

Application to Develop Power on the Sultan River, near Everett, Wash., has been filed with the Federal Power Commission by the Sound Power Co. of New York. The company holds a preliminary permit covering the site and states that it is now ready to proceed with construction. The development will consist of two projects, an upper one with an output of 65,000 hp. and a lower one capable of developing 80,000 hp., the bulk of the power to be used in the pulp and paper industry in the neighborhood. The company expects to make the development at a cost that will not exceed $90 for each installed horsepower.

Dean Cooley a Candidate for Senator from Michigan

Dean Mortimer E. Cooley of the Engineering School of the University of Michigan and past president of the American Engineering Council is a candidate for the Democratic nomination for senator from the state of Michigan to succeed Senator James E. Couzens. Michigan has a primary election in September but at what was termed by its chairman an extra-legal pre-convention conference, held at Flint, Mich., on May 14, Patrick W. Keating, engineer of Detroit, presented the name of Dean Cooley for senator, after which the conference voted unanimously to endorse him for the Democratic nomination.

Discuss Structural Tests

Researches on the strength of metal structures which are now in progress at the Bureau of Standards were reported to the Advisory Committee on Structures and Fabricated Metals which met at the Bureau of Standards, Department of Commerce, on May 20. Represented on this committee are the War and Navy Departments, the engineering societies, iron and steel manufacturers and other commercial organizations, engineering professors, and consulting engineers. A proposal made that the American Society for Testing Materials aid in the calibration of testing machines is to be submitted to the society for action.

N. Y. State Joins Town in Flood Control Construction

State Engineer Dwight B. LaDu and his deputy, Arnold G. Chapman, have been conferring with engineers of Hornell, N. Y., and the flood abatement commission of that city with regard to the plans for relieving flood conditions there. The state engineer has had a survey party working on the project since early in the spring, making surveys, collecting data on stream flow, flood conditions, and methods to prevent the damages caused by high water. Within the last few weeks Hornell has suffered great damage by floods following heavy rainstorms.

The project will provide for the improvement of the Canisteo river and streams known as Chauncey Run, the Canacadea and Crosby Creeks and their tributaries by straightening, widening and deepening the present channels. The state of New York appropriated $200,000 for the project and the city of Hornell a similar amount.

Wisconsin Highway Engineer To Run for Governor

A. R. Hirst Resigns and Announces Candidacy for Republican Nomination

A. R. Hirst has resigned as highway engineer of Wisconsin and, in a letter to the electors of Wisconsin on May 29, announces his candidacy for the Republican nomination for governor of Wisconsin at the September primaries.

Mr. Hirst's letter is a charge against the present governor of Wisconsin. He states that Governor Blaine is carrying out a deliberately conceived plan of building the state government into a political machine devoted to advancing his personal political fortunes, in the process of which he has attempted to gain control of the civil service commission, the prohibition department, the state insurance department, the teachers' pension fund, the game wardens, and other departments.

According to Mr. Hirst, "he has now turned his practiced hand to the task of bending the state highway commission and the state and county highway organizations to his will and purpose, attempting to make the highway forces a political machine and the highway program of Wisconsin and its counties a political asset." This, Mr. Hirst says he shall help to prevent if the power within him lies. He says he cannot effectively fight the program while a state employee and therefore has resigned as state highway engineer and intends to fight it as a candidate for the governorship.

Mr. Hirst has been connected with the highway department of the state for seventeen years, going there from Maryland in 1907. He is a graduate of the University of Maryland, class of 1902, and received the degree of doctor of engineering from that university in 1922. He has been active in the highway engineering field for many years.

Public Health Summer Schools

The U. S. Public Health Service announces that during the coming summer it will co-operate with four universities in conducting public health summer schools. The institutions and dates are as follows: Columbia University, New York City, July 7 to Aug. 15; University of California, Berkeley, June 23 to Aug. 2; University of Iowa, Iowa City, June 9 to July 18; University of Michigan, Ann Arbor, June 23 to Aug. 2, with certain courses continuing for two additional weeks. Those desiring more detailed information should address the deans of the summer schools at the various institutions. The work done at these summer schools may be utilized as counting toward one of several different public health or other degrees.

Ridgway Leads First Ballot for Am. Soc. C. E. President

Leonard Metcalf and I. W. McConnell Far Behind—Total Canvass Is 1,927 Votes

Tellers appointed to canvass the first ballot for official nominees of the American Society of Civil Engineers reported June 2. Total ballots canvassed were 1,927. The report follows:

For President

Robert Ridgway, 744; Leonard Metcalf, 379; I. W. McConnell, 193; Scattering, 423.

For Vice-President, Zone II

Richard L. Humphrey, 207; John C. Hoyt, 204; John E. Greiner, 154; Scattering, 63.

For Vice-President, Zone III

H. R. Safford, 177; M. S. Ketchum, 113; Willard Beahan, 41; Scattering, 61.

For Director, District I

(Two to be elected)

W. T. Chevalier, 217; Charles Gilman, 215; James F. Sanborn, 23; Scattering, 138.

For Director, District 2

C. M. Spofford, 76; C. M. Saville, 56; Scattering, 47.

For Director, District 6

A. R. Raymer, 42; E. K. Morse, 37; C. P. Fortney, 8; Scattering, 10.

For Director, District 10

P. H. Norcross, 43; G. M. Brayne, 34; Scattering, 40.

For Director, District 13

H. D. Dewell, 39; C. H. Sweetser, 5; Scattering, 20.

Names of those who failed to receive 5 per cent of the total ballot are listed as scattering.

Government Control of Muscle Shoals Favored

The Federal Government will not sell its Muscle Shoals properties to Henry Ford. This deduction is placed on the action of the Senate Committee on Agriculture, which early last week voted against the McKenzie bill, which embodies the Ford offer. The committee then voted to report favorably Senator Norris's bill, which provides for a modified form of government operation.

Those who believe that the committee's action killed the Ford bill based their reasoning on the assumption that even should the Senate pass on the Norris bill, of which there is some doubt, that the resulting conference between the two houses would end in a deadlock. Mr. Ford would not accept the compromise measure on which the Senate conferees would insist. In turn, the Senate would not accept a conference bill which would embody the few concessions which Mr. Ford might accept.

As Congress has voted to adjourn June 7 action on the disposition of Muscle Shoals cannot be expected this session.

Minnesota Calls for Road Bids Worth $1,000,000

The Minnesota State Highway Department has called for bids on 25 road and bridge projects, estimated to cost more than $1,000,000, bids to be opened June 24. The list includes 143 miles of grading, more than 90 miles of gravel surfacing and five miles of paving on trunk highways in various parts of the state. This will be the largest single letting to be made by the highway department this year.

Federal Aid Appropriation Cut By House Committee

As a result of the reduction in taxation and the passage of the soldiers' bonus and other measures calling for large appropriations, the bill authorizing appropriations for the continuance of federal aid for highway construction has been reduced from the proposed expenditure of $100,000,000 annually for three years to $75,000,000 annually for two years. Legislation in this form has been approved by the House committee and now awaits action by Congress.

Another point which had weight with the committee is the objection which has been raised to one Congress attempting to commit another.

Existing appropriations expire June 30, 1925. Authorizations for 1926 and 1927 must be made in advance so that surveys, plans and specifications can be prepared. The bill also authorizes $7,500,000 for each 1926 and 1927 for forest roads and trails.

The bill as reported from the House committee continues the policy of authorizing the Secretary of Agriculture to pro-rate the amounts to be available to each state so that they may advertise for bids and arrange contracts prior to the building season.

Chicago Plans Another Large Railway Terminal

The establishment of a large passenger station at Chicago to replace three existing terminals is now under consideration by a joint committee of the railroads concerned, following conferences with Mayor Dever. The three stations to be eliminated are the Dearborn, Grand Central and LaSalle, which together accommodate fifteen railroads. In addition to railroad rearrangements, the straightening of the Chicago River south of Polk St. and the opening of new north and south streets are to be features of the new plans. Members of the committee are: G. A. Harwood (chairman), vice-president, New York Central lines; E. H. Lee, vice-president and chief engineer, Chicago & Western Indiana R. R.; L. C. Fritch, vice-president, Rock Island lines; G. W. Harris, assistant chief engineer, Santa Fe Ry.; L. G. Curtis, chief engineer, Baltimore & Ohio Chicago Terminal R. R.; C. P. Richardson (secretary), engineer of track elevation, Rock Island lines.

Engineering Educators to Meet This Month

Program Announced for Thirty-Second Annual Convention June 25 to 28 at Boulder, Colo.

The program for the thirty-second annual meeting of the Society for the Promotion of Engineering Education, which is to be held June 25-28 at the University of Colorado, has been announced. After a meeting on June 25 of the mining members with the Colorado School of Mines, a meeting of the council at Boulder, an organ recital and illustrated lecture, and a get-acquainted meeting in the evening of June 25, the first professional session will be held the morning of June 26. At this papers on mining engineering and metallurgy will be presented under the direction of Committee Nos. 14 and 18. Reports of officers and committees will follow. In the afternoon the second session will open with the address of welcome by George Norlin, president of the University of Colorado; and a response by P. F. Walker, president of the society, after which an address will be made by H. S. Evans, dean of the college of engineering. Mr. Evans will be followed by a discussion of "Fifteen Years of Experience with a Five-Year Engineering Curricula" by W. H. Burger and J. F. Hayford, of Northwestern University.

Administrative Officers to Meet

On June 27 there will be a meeting in the morning of the division of deans and administrative officers with teachers of English. Later "The Student as an Individual" will be the discussion lead by Carl E. Seashore, dean of the graduate school of Iowa State University. This will be followed by an address by Frank Aydelotte, president of Swarthmore College and by a meeting of the Board of Investigation and Coordination. On the afternoon of June 27, the fourth session will take up a discussion of the Board of Investigation and Co-ordination by its director, W. E Wickenden, and "Attendance at Engineering Schools," by W. C. John, of the Bureau of Education. Discussion will be lead by O. C. Lester, dean of the graduate school, University of Colorado, and C. F. Scott, of Yale. The annual dinner will be held the night of June 27, at which the presidential address will be given.

On June 28, meeting of the institutional delegates will precede the fifth session in the morning, at which "Industrial Development of the West," by Chas. C. Gates; "Chemical Engineering Inspection Trips," by James R. Withrow, professor of industrial chemistry at Ohio State University; "The Freshmen," by C. L. White, freshmen advisor at the University of Washington and "An Experiment in Teaching Freshmen in Engineering How to Study," by Thomas H. Harrison, head of the department of English of North Carolina State College, will be the chief discussions.

In addition to the professional sessions numerous entertainments and trips have been planned by the committee in charge.

Dynamite Blast Damages Los Angeles Aqueduct

Concrete Lining of Open Ditch Is Slightly Shattered Following Water Rights Trouble

A dynamite charge was exploded shortly after midnight, May 21, alongside the Los Angeles aqueduct three miles north of Lone Pine, which is 35 miles below the aqueduct's intake and about 200 miles north of Los Angeles. At this point the water is carried in an open concrete-lined ditch. The explosion cracked and shattered about 100 ft. of the lining but did not destroy the ditch cut. The resultant leakage is said to have been only 6 sec.-ft.; the total flow at this point in the aqueduct was reported to have been 99 sec.-ft. Temporary repair of the damage was effected within a few days and comparatively little water lost.

Blast a Warning

From the nature of the damage it is estimated that enough dynamite was exploded to have wrecked the aqueduct and stopped the flow if set off at a more vulnerable point. From this fact it is reasoned that the blast was intended as a warning that violence would be used in combatting the city's further appropriation of water in the Owens Valley district.

Dissension over water rights in this valley which is in the heart of a desert country dates back many years. In the period from 1902 to 1904 U. S. Reclamation Service engineers surveyed the valley and drew plans for an irrigation district of 100,000 to 200,000 acres. Later, by act of Congress, all data, plans, etc. were transferred to Los Angeles by the Reclamation Service and the hope for extensive irrigation development in the valley ended. However, this was only the beginning of bickerings over water rights which have continued intermittently to date.

Complaint of Farmers

Last fall feeling among Owens Valley ranchers reached a high pitch and threats of violence were made. The complaint of the farmers is not that their water is being taken to supply Los Angeles domestic needs but that it is being used for irrigating the San Fernando Valley at the expense of Owens Valley ranches. The city's policy of buying up rights here and there in the valley, where low prices can be found, has been "freezing out" the remaining ranchers, it is claimed, who foresee that they will soon be unable to carry on if this policy continues.

Recently feeling in the valley has been intensified by the fact that the city has filed suit against all users of water taken from Owens River and its upper tributaries. The farmers fear that this suit may be kept in court indefinitely thus clouding their titles and depreciating the value of their property.

Federal government officials are reported to have taken charge of the investigation of the dynamiting, when it developed that the blast had interrupted interstate telephone communication.

American Engineer Awarded British Victoria Medal

Engineering investigations of a highly scientific character have been recognized by the Royal Geographic Society of England in awarding its Victoria Medal to John F. Hayford, director of the college of engineering, Northwestern University, Evanston, Ill., for his investigation of the theory of isostasy in studies made of the figure of the earth and its structure in relation to the law of gravitation. This investigation was carried on during 1898-1911, while Mr. Hayford was inspector of geodetic work and chief of the computing division of the U. S. Coast and Geodetic Survey. The results have been given in publications of the Survey. In this work, studies of the variation of the plumb line from the true vertical were used to support the theory of isostasy of the earth's structure. The medal was conferred, by proxy, on May 26, on which date Mr. Hayford presented a review of his investigations before the Western Society of Engineers, at Chicago.

Terre Haute Water-Works Sold

The American Water Works & Electric Co. has acquired the property of the Terre Haute Water Works Co., for which Dow R. Gwinn has been president and general manager for many years. Final negotiations depend on permission from the Indiana Public Service Commission to the sale to an intermediary company, the Terre Haute Water Works Corporation and issue by the latter of $1,600,000 first mortgage 6 per cent bonds and $325,000 in cumulative 7 per cent preferred stock, the stock and bonds to be sold to the American Water Works & Electric Co.

Southern Pacific Imperial Valley Case Goes to Court of Claims

After years of investigations, Congress has finally passed legislation referring to the Court of Claims, the determination of the amount due the Southern Pacific R.R. for the work done in connection with the crevasse on the Colorado River in 1906. The Southern Pacific asks to be reimbursed for expenditures in excess of $1,000,000. The company at one time declined a proposal to accept a direct appropriation of $778,000 in full payment. The act, which the President just has signed, recites that this work was undertaken at the request of President Roosevelt and was done under stress of great emergency. It credits the railroad company with having prevented the overflow of more than a million acres of farming land in the Imperial Valley, and with having saved the Laguna Dam and the Yuma Reclamation project. The court is directed to render judgment against the United States for the aggregate amounts necessary to reimburse the company less such proportions of the expenditures as would be fair and reasonable as the Southern Pacific share based on the benefits which resulted to its property and to that of its subsidiary.

WASHINGTON NOTES

Duties of Lieut.-Col. C. O. Sherrill, Corps of Engineers, superintendent of federal buildings and grounds have been interpreted as constituting duty with troops which will permit him to continue in that capacity and as military aide to the President, despite the fact that he has been on duty in Washington for five years.

The Committee on Interstate and Foreign Commerce of the House of Representatives on May 27, following a hearing on the Temple bill which provides for the topographic program necessary to the completion of the map of the United States, met in executive session and ordered the bill reported favorably. Need of complete topographic maps and their utility in special work were presented to the committee by E. B. Mathews, the president of the Association of State Geologists; by A. N. Johnson, National Research Council; S. H. McCrory, American Society of Agricultural Engineers; C. G. Elliot, Illinois Engineering Society; George H. Ashley, state geologist of Pennsylvania; L. W. Wallace, American Engineering Council; William Bowie, American Society of Civil Engineers; and A. C. Olliphant, American Engineering Council.

The Director of the Budget has approved an additional appropriation of $350,000 to apply on the valuation of the property of the railroads being conducted by the Interstate Commerce Commission. This additional appropriation is required to enable the commission to recapture excess earnings by the steam carriers.

As a Result of a Request made by Senator Cummins, of Iowa, and Senator Ransdell, of Louisiana, President Coolidge is expected to enlarge the committee on co-ordination of rail and water transportation by adding to its membership a representative of the Gulf and of Interior shippers. As at present constituted, the committee is made up as follows: Commerce Secretary Hoover, chairman; Henry C. Hall, chairman, Interstate Commerce Commission; Edward P. Farley, chairman, U. S. Shipping Board; Daniel Willard, president, Baltimore and Ohio R.R., and Alfred G. Smith, president of the American Ship Owners' Association.

Under Legislation Passed May 28, the government's barge services on the Mississippi and Warrior Rivers will be conducted under corporate management. The act creates the Inland Waterways Corporation with a capital stock of $5,000,000, all of which has been subscribed by the government. By having at its disposal an adequate capital rather than being dependent upon annual appropriations, it is believed that a greater confidence in the stability of the enterprise will be created. This legislation insures the continuance of the barge service for a period of five years.

Water Shortage at San Francisco May be Caused by Lawsuit

With all storage reservoirs already drawn down to a dangerously low level because of the drought, work on the bay crossing division of the new 60-in. pipeline, which is being rushed to supplement San Francisco's water supply, is being delayed by a lawsuit over the award of a pipe contract to an eastern firm. The new pipe line is being built by the city across the lower end of San Francisco bay and will connect Spring Valley sources with peninsular storage reservoirs, supplementing the present supply until the conduit is needed for Hetch Hetchy water.

About 3,000 ft. of the pipeline is to be laid on the bottom of the bay, using 42-in. flexible-joint pipe. Contract for this pipe was awarded on March 10 to the lowest bidder (the United States Cast Iron Pipe Co. of New York) for $196,000. A local firm, that put in a bid $15,000 higher, protested this award to the eastern firm and secured enough support from local civic and labor organizations to prevent the city from finally closing the contract. The board of supervisors then planned to cancel the contract and call for new bids.

Two suits have been filed in the matter; the firm to whom the contract was awarded entered suit in the Supreme Court against the city auditor for not certifying the contract and a taxpayer entered suit in the Superior Court to enjoin the supervisors from cancelling the contract on the ground that so doing would mean a waste of city funds.

Meanwhile this delay is putting off the date on which the bay crossing can be completed (set at Jan. 1, 1925) and a serious water shortage, it is claimed, may result. Already the water company has issued to all consumers a request for strict water economy and the fire department is using salt water in the high-pressure fire mains.

Byllesby Companies Reorganize

The H. M. Byllesby & Co., consequent on the death, May 1, of H. M. Byllesby, head of the organization, has made the following changes in personnel: Arthur S. Huey becomes chairman of the board of H. M. Byllesby & Co. after having been an original partner and vice-president in charge of operation and management since the organization of the company in 1902. John J. O'Brien is president of H. M. Byllesby & Co. and of the Byllesby Engineering & Management Corp.; Mr. O'Brien also was a member of the original organization.

Of H. M. Byllesby & Co., Robert J. Graf is appointed first vice-president; Mr. Graf started with the company in 1902 as secretary and assistant treasurer, and was made a vice-president in 1914. Henry G. Cummins, nephew of H. M. Byllesby, is named vice-president.

Albert S. Cummins, another nephew of H. M. Byllesby, appointed vice-president of the Standard Gas & Electric Co. and of the Northern States Power Co., was the assistant manager of the bond department of H. M. Byllesby & Co.

Director of the Budget Approves Reclamation Appropriations

Washington Correspondence

The Director of the Budget has approved appropriations for additional reclamation work as follows: Commencement of Guernsey reservoir on the North Platte project, $800,000; commencement of Spanish Springs reservoir, Newlands project, $200,000; and for miscellaneous investigations, $146,500. The North Platte and the Spanish Springs project follow the recommendations of the Committee of Special Advisers on Reclamation, which recently reported. The investigation is to cover the Owyhee and Vale projects in Oregon, the Salt Lake Basin project in Utah, the Kittitas division of the Yakima project, and the Caspar-Alcova project in Wyoming, all but the last of which were recommended by the Advisers. The estimates submitted by the Bureau of the Budget are not adequate, in the opinion of the senators from Nevada and Washington. For that reason, Senator Oddie has introduced an amendment to the forthcoming deficiency bill, increasing the Spanish Springs appropriation to $800,000. Senator Jones has introduced a similar amendment proposing an appropriation of $1,500,000 for the Kittitas unit.

Will Hold International Conference of Sanitary Engineers

An international conference of sanitary engineers is to meet in London, England, the week of July 7. The conference is being held under the auspices of the British Institution of Sanitary Engineers and a number of American sanitary engineers and consulting engineers will be on the program. The preliminary program lists the following as American participants: W. C. Groeninger, John A. Wilson, Prof. George C. Whipple, T. Chalkley Hatton, Harrison P. Eddy, Charles H. Hurd, Langdon Pearse, Victor A. Kadish, John C. McVea, W. L. Stevenson and Thomas J. Classy. In addition to the American participants, there will also be a number of foreign and British engineers on the program.

Progress in Driving Florence Lake Tunnel

The maximum progress to date in driving the Florence Lake tunnel of the Southern California Edison Co. was made during April when the outlet heading (Camp 60) was advanced 578 ft. in hard granite in 30 working days or a daily average of 19.266 ft. The best total progress for the six headings now under way was for the week ending April 26 when the total advance was 709 ft. or an average for the week of 118.16 ft. per heading. Two headings in hard granite have recently been advanced 150 ft. each in one week (21.4 ft. per day) and another heading in seamy granite has been driven 152 ft. in a week. A description of this tunnel and the driving methods used, appeared in *Engineering News-Record* May 3, 1923, p. 776.

Random Lines

An Engineering Distinction

Rep. Dummer: I had understood Mr. Ford wanted Muscle Shoals for the calories.

Sen. Dumm: I will explain. Muscle Shoals are rich in calories. I think there are something like 2,345,834 calories to the shoal.

Unknown Senator (objecting): I rise to correct the speaker. He is laboring under a confusion of names. There are no calories in Muscle Shoals. What Senator Dumm evidently means to refer to is nitrates.

Sen. Dumm: What's the difference?

Rep. Dummer: Don't you know the difference between a calory and a nitrate?

Sen. Dumm: What is it?

Rep. Dummer: A nitrate is what the telegraph company charges you for a message after 6 p.m. A calory is the second balcony in a theater—H. I. Phillips' column in the Associated Newspapers.

* * *

Boston University's course in telephone courtesy will lead, obviously to the degree of civil engineer.—N. Y. *Tribune.*

* * *

A Sporting Proposition

One automobile manufacturer advertises that his frames are made of "Molybdenum Steel, the most athletic of alloys." This personification of inanimate things opens endless copywriting possibilities in the technical field; e.g. the thirstiest of cements, the most hard-hearted of ball-bearings, the most miserly of pipe joints. But just what is an athletic alloy?

* * *

Some Sediment

In recalling a record flood of sixty years ago the Denver *Rocky Mountain News* says:

"There have been portions of the heavy machinery of the *News* office found fast and deep in sandbars, several miles down the Platte. The strangeness of the fact of machinery moving so far distant in a watery current will be lessened by remembering that the waters loaded with hail and sand made bodies float whose specific gravity in the clear element would have immediately fixed them to the bottom of the stream."

* * *

In classifying the occupations of the fathers of a number of boys the Presbyterian *Survey* for June makes the following arrangement:

Professional	17
Physicians	4
Civil Engineers	3
Plumbers	2

What, then, are the professions?

J. C. M.

Great Northern Ry. Work for 1924

Improvement work planned by the Great Northern Ry. for the 1924 season amounts to about $5,595,900, distributed as follows: Changes of line and grade at five points and separation of grades in the northeast part of Minneapolis, $1,722,500; 26 miles of second main track, $1,152,000; replacing 7,100 ft. of timber bridges with permanent structures, $978,000; improving icing facilities at six points, $221,000; new yards, passing tracks and station track extensions, $505,000; automatic block signals between Wolf Point and Havre, Mont., 203 miles, $405,400. In addition there will be $3,660,000 expended for new locomotives and cars.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Meeting, San Francisco, Calif., June 11-13, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Convention, June 18-20, Pasadena, Calif.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 23-28, 1924.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Boulder, Colo., June 25-28.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 23-26, 1924.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

The Wisconsin Section, American Water Works Association, has prepared a program for its meeting at Eau Claire, June 11, 12 and 13 with the Wisconsin League of Municipalities which includes papers on protection of supplies, fire protection, a discussion of the New York convention and a round-table discussion. L. A. Smith, Madison, chairman, states that the section will meet alone on June 12.

The Engineers' Society of Pennsylvania has elected for the coming year the following officers: President, Howard E. Moses, Harrisburg; vice-presidents, E. F. Entwisle, Steelton, and David S. Hammond, Lebanon; secretary, Edward R. Dasher, Harrisburg; and treasurer, Basil M. Graham, Harrisburg.

The Texas Chapter of the Associated General Contractors held its first state convention in Dallas May 15, with representatives from the chapters in Ft. Worth, Dallas, Houston, San Antonio, and addresses by A. J. McKenzie and J. T. Haile of San Antonio, W. C. Henger of Dallas and Thomas S. Byrne of Ft. Worth.

Personal Notes

F. A. GABY, chief engineer of the Ontario Hydro-Electric Power Commission, and HENRY G. ACRES, until recently chief hydraulic engineer of the commission, have received the degree of Doctor of Science from the University of Toronto in recognition of their public service.

HENRY A. COOK, civil engineer, has resigned as secretary and director of the building firm of John Lowry, Inc., to become associated with Robert B. Skinner, builder, of 280 Madison Ave., New York City; the firm will be known as Skinner & Cook.

J. S. LONGWELL, project manager of the Shoshone Project of the U. S. Reclamation Bureau at Powell, Wyo., has resigned.

F. F. SMITH has been appointed superintendent of ditches for the Shoshone Project, U. S. Reclamation Bureau, Powell, Wyo.

J. E. HARRALL, for a number of years superintendent of power distribution for the United Railways & Electric Co., Baltimore, Md., and more recently vice-president of the George Construction Co. of Philadelphia, has become associated with the sales department of the U.G.I. Contracting Co. of Philadelphia.

D. G. SHANNON, formerly in the service of the North Carolina State Highway Commission, has been appointed a resident engineer for the Tennessee State Highway Department, his work to include bridge as well as road construction.

CARL D. POLLOCK, heretofore office engineer, the Alaska R.R., has been appointed bridge engineer of the same railroad with headquarters at Anchorage, Alaska.

CHARLES R. COX, formerly chief chemist of the Bureau of Water, Reading, Pa., assumed on June 1 his new duties as assistant engineer of the New York State Department of Health.

Major D. Q. MCCOMB, who from 1921 to 1923 was chief engineer of the Tennessee State Highway Department, and more recently was president of McComb-Wilson, Inc., consulting engineers and architects of Los Angeles, Calif., has been elected president of the West American Corporation, of Los Angeles, a finance, engineering and construction company.

Obituary

EMIL R. OLBRICH, assistant to the director of the Advisory Board on Highway Research, National Research Council, Washington, D. C., died last week after a long illness, aged 33 years. Mr. Olbrich until recently was construction engineer for the North Carolina State Highway Commission. He was a graduate of Pennsylvania State College and had served in the Philadelphia Bureau of Highways and as assistant professor of civil engineering in the Oklahoma A. and M. College.

JAMES B. BAYLOR, civil engineer, recently retired from the service, at Newmarket, Va., of the U. S. Coast and Geodetic Survey, died May 23 at the home of his daughter in Ruxton, Md.; he was in his 75th year. Included in the important work done by Mr. Baylor was the resurvey of the boundary line between the United States and Canada and tracing, under appointment by the U. S. Supreme Court, of the Virginia-Tennessee and the New York - Pennsylvania state boundary lines. Mr. Baylor was the author of numerous research articles. He was a graduate of the Virginia Military Institute and of the University of Virginia, and entered the Geodetic Survey in 1874.

HERBERT R. PATRICK, pioneer engineer of Phoenix, Ariz., died May 22 in LaJolla, Calif., aged more than seventy years. Mr. Patrick was born in Iowa but went to Phoenix in 1878. He did early location work for the Santa Fé R.R. northwest from Phoenix and between San Diego and Los Angeles. He laid out a number of the canals of the Salt River valley and was engineer for a large irrigation enterprise in the Yaqui valley of Mexico.

MORTIMER H. HOLLENBACK, civil engineer, for many years in the service of the St. Louis & San Francisco R.R., died May 21 at his home in Springfield, Mo., to which he moved in 1882 after being educated in the East. From that date to 1893 he was assistant engineer on the Kansas City, Fort Scott & Memphis R.R., which was then taken over by the above named road. Later he was locating engineer for various Missouri lumber companies and more recently had engaged in general railroad practice with offices in Springfield.

WILLIAM R. SNELSON, JR., civil engineer, who was formerly county surveyor for Grand County and later with the Colorado Highway Department and who went to California about two years ago, died May 19 after a prolonged illness, aged 70 years.

GEORGE LANPHEAR, formerly city engineer of Anderson, Ind., and a resident of that city for 25 years, died recently at his home there from an apoplectic stroke suffered two weeks before in St. Louis, Mo.

FRANK M. YOUNG, for the past five years resident engineer for the Department of Highways of the state of Delaware, died May 15 at his home in Dover, Del., in his sixty-third year. Mr. Young's early engineering work was on railway location and construction in the West and in Canada, on the Northern Pacific, the Great Northern and the Canadian Pacific. For the last named he was resident engineer when the line was constructed through the mountains in British Columbia and on grade reduction on the main line between Swift Current and Medicine Hat and the construction of the Kootenay Central Branch.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Construction Equipment—Past and Present

A Series of Historical Sketches of the Origin and Development of Machines for Contractors and Engineers

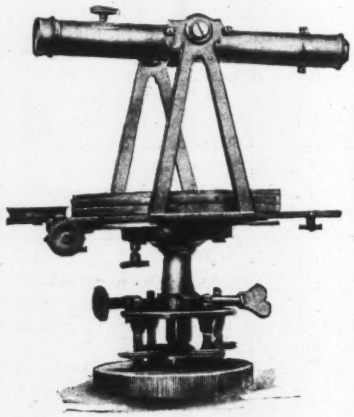
V—Surveying Instruments

JUST fifty years ago, in the first issue of this journal which appeared under the name of *The Engineer and Surveyor*, in April, 1874, there appeared an article on "The Importance of the Art of Surveying," from which the following quotation is taken: "Surveying was introduced into Europe by Thales about 600 B.C. and soon became so necessary to the proper administration of every-day business life that some of the most celebrated philosophers and mathematicians of antiquity gave their attention to the study of its principles and the improvement of its practice. To their labors the world has ever since been indebted. From unknown boundaries the ancient world has been resolved into exact outlines of continents, islands, oceans, seas, lakes and rivers that constitute the globe on which we live."

First Transit by Young—In the history of American engineering the year 1831 is notable for the production of the first transit by William J. Young, of Philadelphia. As in the case of other engineering equipment, its principal uses were in connection with railroad location and construction. A photograph indicating the general design features of this pioneer American transit is reproduced herewith. The instrument was graduated to read by vernier to 3 min., for in the earlier days the idea was prevalent that graduation to 3 min. could be readily read to 1 min. and was less perplexing to use. The instrument, designed as an improvement on the English theodolite, had an "out-keeper" for tallying the outs of the chain and a universal or round level. The needle was 5 in. long and the telescope 9 in., of low power.

Latest Transit of Buff & Buff

The standards of this early machine were in the form of an inverted V. The center between plates was flat with the vernier on the inside of the needle ring; the plates moved upon each other by rack and pinion mechanism. There is some dispute as to the first use of this instrument, one claim being on the state works of Pennsylvania and the other by the Baltimore & Ohio R.R. whose engineers made the first suggestion for modifying the old form of theodolite.



Young's First Transit

A commentary on the development of the transit is found in *Engineering News* of Sept. 15, 1875, where it is stated that since Young made his first instrument "transits have been little improved and have been changed in the wrong direction. They are generally much heavier than formerly, containing as much brass and mahogany as one man may well stand under. This great weight is not only useless but dangerous."

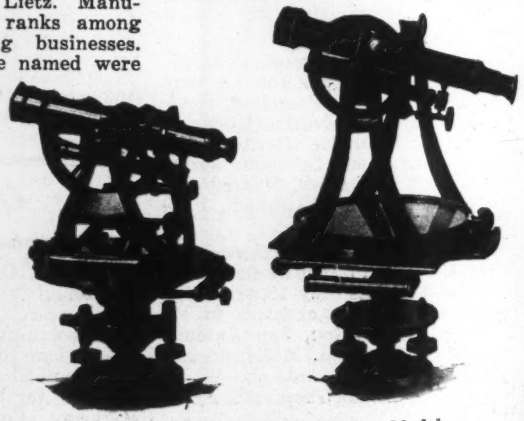
The Older Makers—Young was followed by other instrument makers whose names have become bywords to every engineer who has worked on surveys, among them being Gurley, Heller & Brightly, Buff, Berger, Brandis, Keuffel & Esser, and Lietz. Manufacture of instruments ranks among the veteran engineering businesses. Most of the firms above named were established more than half a century ago. Even after the transit had been developed into a fairly accurate instrument, engineers were slow to avail themselves of its use. For example, we find in the July 15, 1874, issue of this journal's predecessor, *The Engineer and Surveyor*, an article by Leo Strassberger, an instrument maker of that time, which says:

"Though of late many surveyors have adopted the transit instead of the compass, there are still a great many, if not the majority, who run their lines exclusively by the latter; and as regards correctness depend entirely on the delicacy of the needle."

The accuracy of any instrument for angular measurement depends in large part upon the precision of its graduations. Improvements in the transit owe much to the development by Young, Buff and others of graduating engines which cut lines at equal distances and of equal thicknesses down to a minute fraction of an inch.

New Alloys—The older forms of surveying instruments were heavy and unwieldly, with screws, bubbles, and other parts exposed to damage. In the manufacture of the modern instruments the constant effort has been to secure the minimum of weight consistent with stability and to make the instrument compact. For the yellow brass used by the instrument makers of half a century ago, new alloys have been substituted and working parts have been protected by dustproof and watertight coverings. The flat plates of the older models have long since been superseded by ribbed and dished forms, resulting in less weight and greater rigidity. Stability and ruggedness have been secured by a one-piece standard for supporting the telescope, an improvement which is emphasized in the Gurley instrument. In this instrument the practice is to use for the cross-hairs finely drawn platinum wire, although most of the other manufacturers retain the spider web for this purpose.

With the adoption of new alloys for the main parts of transits and levels have come, also, refinements in heat-treating the castings and the elimination of inequalities in expansion. Among the leading instrument makers today great mechanical precision is insisted on. The two telescoping tubes of the Buff transit, for example, contain no device such as a spring tongue



Modern and Ancient Gurley Models

to prevent wobbling but are built of drawn brass tubes accurately fitted through their entire length of sliding contact.

A comparison between an old and a new model of transit shows a better balance in the later machine. The first transits all have a top-heavy look, while the newer units are compact and sturdy, with a lower center of gravity. Recent developments are due in some degree to a change in methods of transport employed by engineers and contractors. The modern surveying instrument must be built to stand up under the jars and jolts of journeys by motor car or truck. A number of special models of transit and level have appeared within recent years, designed particularly for use in mine and tunnel work. They embody features to meet special conditions such as increased visibility when working in dim light and protection of all parts from dripping water.

The foregoing are some of the principal developments that have occurred during the past fifty years or so in engineering instruments. The accompanying illustrations indicate several stages in the evolution of the transit.

Additional articles in the series, "Construction Equipment — Past and Present," will appear in forthcoming issues.

Additional Notes on History of the Power Shovel

Supplementing the historical sketch of the power shovel that appeared in "Engineering News-Record," May 1, p. 785, the following notes have been received from the Thew Shovel Co., Marion, Ohio.

CAPT. RICHARD THEW, founder of the company that bears his name, was born in Marion, Ohio, and entered the hardware business in that town where the chief industry was the manufacture of steam shovels. As a result of experience gained later as captain of a steamship on the Great Lakes, he devised a distributor which was a sort of plow for distributing a cargo of ore in a ship. At that time there were no overhead cranes for handling ore on the docks and the steam shovel, as then constructed, was not adapted to handling the ore on account of its damage to plank floors.

Capt. Thew utilized some of the ideas for his distributor in developing the horizontal crowd boom. At the same time he developed the full-circle-swing shovel and thus designed the first Thew steam shovel in 1895. In addition to being the first revolving or full-circle-swing shovel, the Thew was the first to be equipped with wide-tired traction wheels instead of car wheels.

The first Thew shovels were used to handle ore on the docks. Soon the brick yards began to purchase them and their use was quickly extended to cement plants and quarries. Contractors became interested and were soon taking a large portion of the output.

The company built a few large railroad machines and a dredge or two but soon decided to confine its output to small revolving shovels. In 1903 the first Thew electric shovel was built. Electric power was not widely distributed at that time and sales were few for a number of years. Now they form about one-third of the company's yearly output.

The first Thew gasoline shovel was sold in 1915. The gasoline engine at that time was not fully developed for heavy duty and it was not until the perfected four-cylinder engine was adopted on the present type machine that sales mounted to an equality with electric and steam machines.

While the company built shipper shaft boom shovels at various times, it was decided in 1919 to discontinue the horizontal and standardize on the plate-girder type shipper shaft and crowd boom.

Capt. Thew did business under the name of the Thew Automatic Shoveling Co. and his first shovels were built by the Variety Iron Works of Cleveland. A total of eight shovels were built in the four years from 1895 to 1899. The Thew Automatic Shovel Co. was incorporated in 1899 with F. A. Smythe, president and Richard Thew, vice-president. A small plant was built in Lorain, Ohio. The plant has been enlarged from time to time and the capitalization increased. The present company was organized in February, 1920, at which time Capt. Thew and some others retired. Mr. Smythe remained as president and soon after H. E. Billington became manager of sales, later being elected vice-president for sales.

Suit Involving Cutting Torch Makers Ended

Taking the case from the jury and directing a verdict for the defense, Judge Morris A. Sopor in the U. S. District Court at Baltimore May 9 ended the suit for alleged conspiracy to violate the anti-trust laws brought by the Alexander Milburn Co., of Baltimore, manufacturer of oxyacetylene welding and cutting apparatus against the Union Carbide and Carbon Corporation, New York, six alleged affiliated companies and the Davis-Bournonville Co., New York. The damages claimed were $2,250,000. The court in reviewing the testimony, said, in part:

"The inevitable conclusions from a recital of the testimony is that the plaintiff failed in both branches of the conspiracy charged. The evidences not only failed to establish an agreement between the defendants for the allotment of Government business to one defendant and the railroad business to the other party to the conspiracy, but the evidence affirmatively shows that each of the parties to the alleged conspiracy actively and energetically endeavored to secure business in the field forbidden to it under the terms of the alleged combination. It is difficult to resist the conclusion that the plantiff has availed itself of the wide latitude which the character of its complaint afforded to make reckless charges which it had no sufficient evidence to sustain."

Counsel for the Milburn company announced that the case will be appealed to the United States Circuit Court of Appeals at Richmond, Va.

Fred G. Hudson New Secretary of Highway Industries Association

To fill the vacancy caused by the resignation of K. H. Talbot, the Highway Industries Exhibitors Association has appointed as secretary Fred G. Hudson, Western manager of *Engineering News-Record* at Chicago. Mr. Hudson has served for several years on the Board of Directors of the association; the vacancy on the board created by the new appointment has been filled by the selection of P. L. Griffiths, of the American Tar Products Co. Mr. Talbot recently severed his connection as manager of field service for the Koehring Co., Milwaukee, manufacturer of concrete mixers and cranes.

Business Notes

LOCK JOINT PIPE CO., Ampere, N. J., announces the addition to its personnel of Col. F. F. Longley, formerly of the staff of Hazen, Whipple & Fuller, consulting engineers, New York, and during the war officer in charge of the Water Supply Section of the Engineer Department of the American Expeditionary Forces in France. After the war, Col. Longley returned to Europe as a specialist in sanitary and public health engineering for the League of Red Cross Societies and for the Rockefeller Foundation. He has recently returned to the United States from Australia, where he served as advisor on water-supply and sewerage problems to the Department of Health of that commonwealth, with headquarters in Melbourne. His duties with the Lock Joint Pipe Co. will include technical advice on water-supply and sewerage problems and work of a general promotional nature.

BUFFALO FORGE CO., Buffalo, N. Y., announces the opening June 1 of a new western office at Seattle, Wash. The territory of this office will include Oregon, Idaho and Montana in addition to Washington and Alaska. Arthur T. Forsyth, of the company's Buffalo plant, will be western representative in charge.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., East Pittsburgh, Pa., is making an addition of approximately 120,000 sq.ft. of floor space to its Homewood Plant in the form of three new factory units now under construction. The new units, which will be of modern concrete construction, will be combined in a four-story and basement building, with a two-story materials building adjoining, and will be devoted entirely to the manufacture of renewal parts and coils for electrical apparatus. In this, the new buildings will supplement existing plant area, bringing the total floor space devoted to this work to 200,000 square feet. The additional units, which are being built by the Hughes-Foulkrod Co., general contractors, will be ready for occupancy about Nov. 1, and will give employment to about 1,000 men. The buildings with their equipment will cost about $700,000.

Equipment and Materials

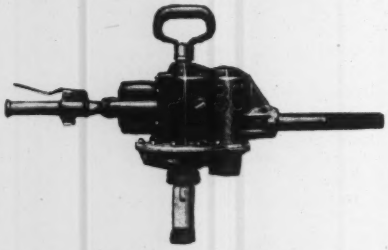
Rigid Sheets of Gypsum Used for Exterior Sheathing

Gyp-Lap, a new product of the United States Gypsum Co., Chicago, is an exterior sheathing consisting of rigid sheets of pure gypsum encased in tough fibre casing, 32 or 48 in. wide and 6 to 10 ft. long. Like Sheetrock, the fireproof wallboard, Gyp-Lap can be nailed and sawed like lumber. Among its advantages the manufacturers specify the following: It costs less than wood sheathing; it insulates heat and cold, saving fuel; it is windproof and does not warp; it is a firestop. Coming in large sheets it supports the structure better than wood sheathing, saving time and labor and reducing dead-load 20 per cent.

G. F. Gebhart, consulting engineer at the Armour Institute, recently conducted comparative tests of Gyp-Lap and wood sheathing. On a frame of 2 x 4 in. studs spaced 16 in. on centers, similar to actual wall construction and nailed securely at top and bottom, the frame covered with ordinary shiplap was deflected 4 in. out of plumb at 600 lb. horizontal pull. A similar frame sheathed with Gyp-Lap was only 1¼ in. out of line at a pull 90 lb.

Portable Air Drill for Reaming

Designed especially for coping with the wide fluctuations of load encountered in reaming operations, a new portable, one-man piston air drill,



known as the Red Giant, is announced by the Chicago Pneumatic Tool Co., New York. The machine weighs 35 lb. and is adapted to down or side-hole reaming. Cylinders and pistons are of the double-acting type with connecting rods attached to crossheads by a standard design of wrist pin. Valves are of the balanced piston type moving about one-twentieth of their length. The crankshaft, mounted on three ball bearings, is of nickel steel, the eccentric being an integral part of the forging. Splash lubrication is used.

The manufacturer points out that the duty which a reaming tool is called upon to perform is generally variable. The work may range from single plates to a multiplicity of plates and gussets, with forgings, grey iron or steel castings interspersed. The quantity of metal to be removed produces a constantly changing power factor, a condition which has been taken into consideration in the design of the drill.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

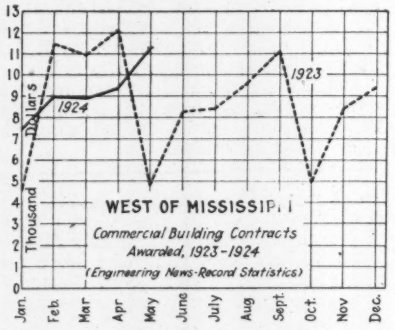
Construction Gains in States Immediately West of the Mississippi

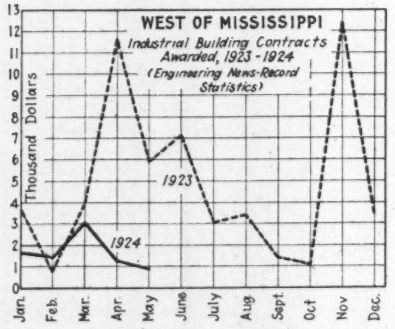
The unfavorable condition in the states immediately west of the Mississippi seems to be purely an agricultural one rather than one of construction. It is reported that the Secretary of Agriculture has found in the fifteen wheat states that more than 108,000 farmers since 1920 have lost their farms or property through foreclosures or bankruptcy. Over 122,000 lost their property without legal proceedings and nearly 373,000 have retained their property through the leniency of creditors. This makes a total of 603,000 farmers or 26 per cent of all who are virtually bankrupt in these fifteen states. During the four years—1920 to 1923, 1,357 state and national banks have failed with total liabilities of more than $500,000,000. This agricultural condition has caused in the first three months of this year 265 banks to fail with liabilities of $100,275,600.

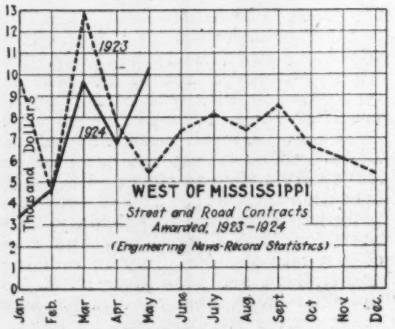
The year 1923 is considered the record year in construction and offers a basis for present comparisons. From this angle with the first five months of the present year compared with the same period of last year, also May, 1924, with May, 1923, the building situation in this section is prosperous. The totals of all construction for the years 1924 and 1923 are $144,645,000 and $159,463,000 respectively. May construction for these years compared gives $48,761,000 and 25,589,000 in favor of May, 1924. These totals may be compared with the April, 1924, total of $24,504,000.

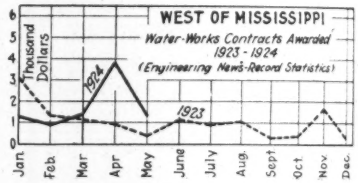
The following table compares the 1924 construction situation with that of a year ago, month by month for the first five months:

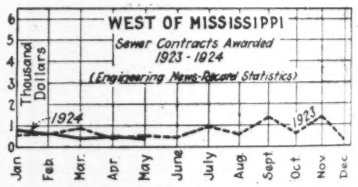
	1924	1923
January	$21,273,000	$25,391,000
February	21,290,000	21,450,000
March	28,817,000	50,648,000
April	24,761,000	36,385,000
May	48,761,000	25,589,000
Total	$144,645,000	$159,463,000

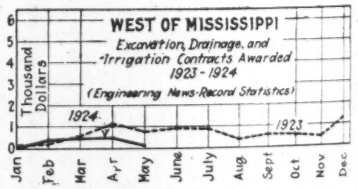


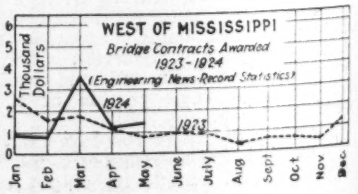



WEST OF MISSISSIPPI
Street and Road Contracts Awarded, 1923-1924
(Engineering News-Record Statistics)
Thousand Dollars
1923
1924
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.






WEST OF MISSISSIPPI
Excavation, Drainage, and Irrigation Contracts Awarded 1923-1924
(Engineering News-Record Statistics)
Thousand Dollars
1924
1923
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



May Heaviest Month In Volume of Construction Since October, 1919

Gains in All Classifications Except Bridges and Excavations—All Sections of Country Show Increases Over April

The total value of contracts awarded on large engineering construction projects, as published in the five issues of *Engineering News-Record* during May, reached $257,665,000, against $174,915,000 in the four issues of April, 1924. The May, 1923 total was $218,712,000.

This gives an average weekly value of $51,533 000 for May, compared with $43,728,750 for each week of the preceding month.

The actual physical volume of May construction, that is, the quantity of materials used, was 20 per cent greater than that for the corresponding period last year and also represented the heaviest volume of any of the months since October, 1919.

Minimum costs observed in the Construction News Section of *Engineering News-Record* on each class of construction are as follows: Water-works and excavations, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

Construction was more active in May than during the month preceding in all parts of the United States and Canada.

The May total of bridge contracts fell off 43 per cent and excavations, 53 per cent in money value as compared with the month preceding. All other classifications gained.

The May volume was 8 per cent below that for the corresponding period in 1922; 82 per cent above the same month in 1921 and 53 per cent greater than May, 1920.

Among the large projects awarded during May were the following: An apartment, New York N. Y., $4,000,000; subway, Brooklyn, N. Y., $3,948,831; tunnel, Los Angeles, Calif., $3,500,000; railway, Idaho and Nevada, for the Northern Pacific Ry., $3,500,000; asylum, Secaucus, N. J., $3,367,111 and a hotel, Dallas, Tex., $3,250,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 325 to 341, are the folowing:

High School, Trenton, N. J., by Bd. of Educ. $1,000,000.

School, Kenosha, Wis., by Bd. of Educ. $1,000,000.

Chicago Votes $17,000,000 For Improvements

An affirmative vote on the following four bond issues was cast in Chicago, June 2: (1) Clearing out of South Water St., $10,000,000; opening up of Roosevelt Rd., $1,000,000; South Park Ave. improvement, $1,000,000 and saving of the Fine Arts Building, $5,000,000.

Engineering News-Record Construction Cost Index Number

June, 1924	216.85
May, 1924	222.38
June, 1923	220.70
Peak, June, 1920	273.80
1913	100.00

Jan., 1923	191.70	Sept.	221.50
Feb.	197.40	Oct.	220.30
Mar.	205.25	Nov.	220.90
Apr.	213.50	Dec.	217.30
May	216.70	Jan., 1924	217.90
June	220.70	Feb.	220.30
July	222.10	Mar.	224.70
Aug.	221.50	Apr.	221.60

Engineering News-Record's Construction Cost Index Number declined 5.53 points since last month, owing to lower steel and lumber prices. The average rate for common labor is still 56c. per hr., against 55c. two months ago and 51c. in May, 1923. Thus, general construction cost is 2 per cent lower than one year ago and 21 per cent under the peak; it is 117 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

May, 1924 *(5 issues of E. N.-R.)*	206
April, 1924 *(4 issues of E. N.-R.)*	137
May, 1923 *(5 issues of E. N.-R.)*	171

Yearly

1923 (entire year)	135
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1919 (entire year)	91
1918 (entire year)	80
1917 (entire year)	64
1913 (entire year)	100

Engineering News-Record's Construction Volume Index Number is 206 for the month of May, and 135 for the whole of 1923, as against 100 for 1913. This means that the actual volume of construction in 1923 (not the mere money-value of the contracts let that year) is 35 per cent above the volume of construction for 1913. Our monthly volume number, 206 for May, 1924, contains the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA, MAY, 1924

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Western	United States	Canada	Grand Total
Waterworks	1,814,000	$1,887,000	$343,000	$3,208,000	$1,658,000	$3,082,000	$11,992,000	$211,000	$12,203,000
Sewers	253,000	2,368,000	252,000	4,377,000	492,000	227,000	7,969,000	754,000	8,723,000
Bridges	177,000	973,000	877,000	1,840,000	1,797,000	259,000	5,923,000	143,000	6,066,000
Excavation, drainage, etc.	26,000	212,000	709,000	84,000	130,000	130,000	1,291,000		1,291,000
Streets and roads	974,000	14,423,000	13,638,000	15,743,000	12,854,000	5,528,000	63,160,000	2,194,000	65,354,000
Industrial works	280,000	7,708,000	951,000	4,332,000	1,233,000	1,864,000	16,368,000	455,000	16,823,000
Buildings	5,287,000	35,008,000	7,977,000	24,192,000	14,142,000	12,073,000	98,679,000	5,950,000	104,629,000
Federal government	72,000	852,000	2,513,000	397,000	111,000	5,000	3,950,000		3,950,000
Unclassified	475,000	8,074,000	390,000	325,000	16,344,000	8,794,000	34,402,000	4,224,000	38,626,000
Total	$9,358,000	$71,505,000	$27,650,000	$54,498,000	$48,761,000	$31,962,000	$243,734,000	$13,931,000	$257,665,000

Labor Rates and Conditions Throughout the Country

Employment, particularly in the manufacturing industries, has been steadily declining throughout the entire country since March, according to the U. S. Bureau of Labor Statistics.

Increases, however, were reported in the following industries: Brick, tile, terra-cotta, steam fittings, cement, sawmills and mill work. The gains in employment in these industries were due mainly to the sustained building demand.

A recent survey conducted by the National Industrial Conference Board reveals a drop in average hours of work per week and average hourly and weekly earnings per wage earner for the entire country. A slight decrease in the cost of living is also reported, particularly in food and fuel.

The three most active industries at the present time are: (1) Building; (2) building materials and equipment and (3) petroleum.

There is a tendency to curtail operations, however, in the iron, steel, automotive, clothing, shoe and textile industries.

The average rate paid common laborers (pick and shovel men) in construction operations is 56c. per hr. for the entire country. The rate was the same last month; 55c. in April and 54c. from July, 1923 to March, 1924. Local conditions as reported to *Engineering News-Record* follow:

Baltimore—Conditions normal in the building trades, although unemployment is reported in other industries.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.70	$0.70	$0.50	.....	$0.75	$0.25@.30
Baltimore	1.75	.90@1.20	1.00@1.12½	1.00	$0.65	1.12½	.40
Birmingham	+1.25	1.00@1.25	.50@1.00	.30@.40	.....	1.00	—.25@.40
Boston	1.25	1.00@1.10	1.25@1.35	.82½	1.05	1.12½	.60@.75
Cincinnati	1.50	+1.20	+1.20	.92½	+1.20	+1.20	+.55
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.50	1.25	1.25	.87½	1.00	1.37½	.87½
Dallas	1.50	1.00	1.00	.40@.75	.87½	1.00	.30@.50
Denver	1.62½	1.12½	1.12½@1.18¾	+.81¼@.87½	1.00	1.15⅝	.35@.55
Detroit	1.50	.90@1.00	.85@1.00	.90	.85@1.00	1.12½	.60@.75
Kansas City	1.37½	1.12½	1.00@1.25	.90	1.00	1.15	.40@.70
Los Angeles	1.25	.100	1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	+.55
Montreal	1.00	.65	.62½	.45	.50	.65	—.25
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00	1.31¼	.62½@.75
Philadelphia	1.50	1.12½	1.02½	.70@1.00	1.00	+1.12½	—.40@.45
Pittsburgh	1.40	1.37½	1.25	1.00	.....	1.25	.70
St. Louis	1.75	1.50@1.60	1.50@1.67½	1.15@1.25	1.25	1.50	.45@1.10
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	.93¾	1.00@1.12½	1.12½	.62½

Birmingham—Work plentiful in the building trades. Wage reductions, however, reported in iron and steel operations in this district. Bricklayers advanced 25c. per hr., making $1.25.

Cincinnati—Carpenters, hoisting engineers, pile drivers and structural iron workers advanced 5c. per hr.; hod carriers' and common laborers' rates increased 2½c.

Dallas—Skilled trades in good demand; but little unemployment among common laborers.

Detroit—Labor supply becoming more plentiful owing to curtailment of production in most industries.

Minneapolis—Labor plentiful, both skilled and unskilled; building activity lessened.

Montreal—Ample supply of all building crafts.

New Orleans—Labor plentiful, all grades. Electricians and plumbers have presented demands for higher wage rates upon expiration of present contracts.

New York—Deadlock prevails in strike between two New York locals of the International Association of Bridge and Structural Iron Workers and employers, members of the Iron League of New York. The iron workers demand $12 per day against the present rate of $10.50 and also abolition of the open shop. Labor conditions are normal in other trades.

Philadelphia—Surplus of carpenters, hoisting engineers and common laborers. About ten per cent of the structural iron workers now on strike.

Pittsburgh—No adjustments in wage schedules either in the building trades or in the steel mills. About 5,000 carpenters on strike over contract disagreement.

St. Louis—Building trades craftsmen, recently on strike, have all returned to work with slight advance in many instances.

San Francisco—Construction active; all building crafts employed.

Monthly Prices of Construction Materials

Ups and Downs of the Market

General Price Tendency Is Down, With Production Curtailed and Demand Light

Pig Iron—Slight improvement in pig-iron demand; the few large tonnage purchases now in the market have not caused any changes in published price schedules. Current quotations on No. 2 fdry. Southern are about $4 per ton below a year ago. There has been general restriction of production consistent with falling demand.

Railway Supplies—Light rails easier at Pittsburgh mill. Spikes and track bolts down at Pittsburgh and Birmingham. Little demand for freight car material.

Pipe—Compared with other lines the steel pipe trade is in fairly good shape; no shading of mill or warehouse prices reported. Sewer pipe lower at Pittsburgh mill so far as smaller sizes are concerned. Cast-iron pipe declines reported in Birmingham, St. Louis and San Francisco.

Road and Paving Materials—Asphalt higher than month ago in St. Louis, Detroit, Cincinnati and Philadelphia. Curbing and wood block paving lower in St. Louis.

Sand, Gravel and Crushed Stone—Sand down 25c. per cu.yd. in New York and Minneapolis since last month; advance of 15c., however, reported in St. Louis and 11c. per ton in Birmingham. Gravel higher in St. Louis. Few changes in crushed stone aside from declines in Minneapolis and St. Louis.

Lime—Advances balance declines in nineteen cities reporting to *Engineering News-Record* during month.

Cement—Prices are about the same as last month and slightly below a year ago in thirty cities reporting. Reserve mill stocks heaviest on record for this time of the year.

Steel—Demand and production decreasing; prices weaker. Reinforcing bars holding at $2.20@$2.25 per 100 lb., f.o.b. mill; shapes, $2.25@$2.30 with $2.10 mentioned; plates quoted at $2@$2.25 per 100 lb., Pittsburgh. These prices are about 20c. per 100 lb. under those prevailing one month ago.

Brick and Hollow Tile—Brick demand good and production active. Declines are reported in Minneapolis and Philadelphia; drop of $1 per M, in the former and $2 in the latter.

Lumber—Demand dropped off considerably during the past week, although shipments on orders previously placed were about the same as the week before. There was a small increase in production. The entire lumber movement is slower than a year ago; prices tending downward throughout the entire country.

Explosives—No price changes reported; none anticipated.

Scrap—Trend of iron and steel scrap market upward. Present price of heavy melting steel, however, slightly below month ago.

Linseed Oil—Raw oil (5 bbl. lots) 98c. per gal. f.o.b. New York, against 95c. one month ago. Advance in flaxseed market checked.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	June 5	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$25.05	$31.55
Northern Basic	24.00	32.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	24.00	33.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	28.00	34.94
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	22@23	27.00
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	24.25	32.64
Virginia No. 2 (silicon 2.25 @ 2.75)	28.17	35.17
Basic	24.00	31.50
Gray Forge	24.00	30.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	24.50	33.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	27.00	33.01
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	25.77	31.00
Basic	25.77	31.00
Bessemer	26.77	31.00

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14.00	$11.50	16@16.50
Stove plate	10.00	12.00	16.00
No. 1 machinery cast	14.00	16.50	19.50@20
Machine shop turnings	8.00	4.00	12.50@13.50
Cast borings	9.00	5.50	14.00
Railroad malleable	13.00	12.50	21.00
Re-rolling rails	14.00	13.00	21.50@22
Re-laying rails	*22.00*	30.00	28.00@31
Heavy melting steel	*10.50*	.....	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb is charged extra:

	Pittsburgh				
	June 5	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$46.00
Standard openhearth rails	43.00	43.00	43.00	43.00	46.00
Light rails, 8 to 10 lb	*38@40*	45.00	2.00*	43.00	2.55*
Light rails, 12 to 14 lb	*38@40*	45.00	2.00*	43.00	2.45*
Light rails, 25 to 45 lb	40.00	45.00	2.00*	43.00	2.35*
Rerolled Rails	37@38	.....	.....	.....	2.10*

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.70	$1.90
Chicago, Hardwood and Red Oak	1.35@1.45	1.50@1.70
Chicago....Empty Cell Creosoting (add'l)	.50	.60
San Francisco..... Green Douglas Fir	.84	1 14
San Francisco, Empty Cell Creosoted Douglas Fir	1.70	2.25
St. Louis, White Oak	1 30	1.60
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.50
St. Louis, Sap pine-cypress	1.05	1.35
Birmingham, white oak	1.75	1.85

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	June 5	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	*$2.90*@3.00	$3.15	$3.00	$3.85	$4.85	*$3.70*
Track bolts	*3.75*@4.00	4.25@4.50	4.00	3.90	5.85	*4.66*
Standard section angle bars	2.75	2.75	2.75	3.45	4.00	*3.10*

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1¼	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1¼	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	48%	50%	61%	49%
2½ to 6 in. lap welded	44%	47%	58%	46%

	Galvanized			
	New York	Chicago	Birmingham	St. Louis
1 to 3 in. butt welded	34%	37%	50%	36%
2½ to 6 in. lap welded	30%	34%	48%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4%, less 5%; class A, plus 23%. Cast iron, standard sizes, 34@5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York	
			June 5	One Year Ago
4 in.	*$51*@53	**$66.60@68.60**	$66.60@68.60	$66.50@67.50
6 in. and over	49.00	61.60@63.60	61.60@63.60	62.50@63.50

	Chicago	St. Louis	San Francisco
4 in.	$60.20@64.20	*$56.60*	*$63.00*
6 in. and over	57.20@60.20	*52.60*	*59.00*

Gas pipe and Class "A," $5 per ton extra.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

	New York					
Size, In.	June 5	One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$23.00
4	55.00	55.00	50.00	75.00	$76.50	83 00
5	80.00	80.00	...	100.00	97.75	108 00
6	105.00	105.00	85.00	175.00	127.50	133 00
8	170.00	170.00	195.00	187.50	212.50	199 00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	*$0.099*	$0.15	.....	$0.15	$0.12	.....
4	...	*.099*	.11	$0.1175	.15	.15	$0.15
5	.....	*.1485*	**.1380**	.....	.23	.18	.18
6	$0.24	*.1485*	.165	.1645	.23	.21	.21
8	.38	*.231*	*.25*	.26	.35	.30	.325
10	.57	*.3465*	.338	.364	.53	.42	.476
12	.72	*.4455*	**.452**	.468†	.68	.54	.612
15	1.13†	*.594*	65	.78†	.90	.90	.102
18	1.65†	*.825*	**86**	1.092†	1.25	1.32	1.153
20	1 98†	*.99*	1.125	.....	1.50	.....	.....
22	2 64†	*1 32*	1.375	1.456†	2 00	.....	1.564
24	2.97†	*1 485*	1.625	1.872†	2.25	2.16	2.04
27	4.81†	2 795	2.80	2.95†	4 69†	3.00	3.34
30	5 33†	3 096	....	3.65†	5.94†	3.60	4.06
33	6.93†	4 14	....	4.45†	6.88†	.....	4.99
36	7.91†	4 715	....	4.80†	7.50†	.....	5.42

	3	5	8	12	24	36
Boston	**$0 135**	**$0 216**	**$0 33**	**$0 65**	**$2.15†**	**$6.35†**
Minneapolis	.....	.....	40	.72	2.55†	5.66†
Denver	.135*	.18*	27	47	1.70	.....
Seattle	.13	.....	.36	72†	2.60†	.....
Los Angeles	16	195	275	475	1.65	.....
New Orleans	.148*	.207*	.345	.586	1.182	.....
Cincinnati	.111	.1665	.259	4995	1.665	4.92
Atlanta	.11*	.135*	.225	.3825	1.4625	.....
Montreal	68‡	45†	70	1.35	4.50†	.....
Detroit	108	.162	.252	.486	2.205†	5.8425†
Baltimore	.117	.175	.273	.5265	1.755	5.125
Kansas City, Mo	.15*	.21*	.33	.60	.....	.....
Philadelphia	.12	18	.28	.54	1 80	*4 61*

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal minimum f.o.b. place named:

		June 5	One Year Ago
New York, 45% asphalt	(at terminal)	$0 053	$0.0525
New York, 65% asphalt	(at terminal)	051	0525
New York, binder	(at terminal)	06	06
New York, flux	(at terminal)	04	0575
New York liquid asphalt	(at terminal)	.048	.06
St. Louis, 40@50% asphalt		.048	.0535
St. Louis, 50@60% asphalt		.049	.0565
Chicago, 40–50% asphalt		.0525	0525
Chicago, 60–70% asphalt		.055	055
Dallas, 45% asphalt		.0495	049
Dallas, 55% asphalt		.0455	0455
Dallas, binder		.061	061
San Francisco, binder, per ton		9.50*	9.50*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Standard refined Mexican*)	$19@20*	$15@16
Boston (*Mexican*)	21.50	16.50
Chicago (*Stanolind*)	21.00	15.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00	11.00
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24.75	20.50
Denver (*California*)	24.00	....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25.10	19.10
St. Louis (*Trinidad*)	**33.00**	**31.00**
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	32.00	28.50
Detroit (*Mexican*)	**22.00**	**18.00**
Cincinnati (*Kentucky Rock*)	....	**11.65**
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	20.50	17.50
Philadelphia (*Mexican*)	**22.00**	17.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00
Birmingham (*Mexican*)	32.00	29.00

*In drums.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$140.00 per M.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	2.95 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite, 28 blocks per sq.yd.	**137.00** per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	137.00 per M.
St. Louis	4x8x4 dressed	1.75 per sq.yd.
	4x8x4 common	1.75 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 85c.: 5 x 20 in., Queens, 95c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., 90c. per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.29
New York (*delivered*)	3½	16	2.56
Boston	3½	18	**2.75**
Chicago	4	16	3.20
Chicago	3½	16	2.90
St. Louis	3½	16	*2.35*
St. Louis	4	16	*2.65*
Seattle	4	16	Off market
Minneapolis	3½	16	2.75
Atlanta	3½	16	2.00
New Orleans	3	16	1.70
New Orleans	3½	16	2.10
New Orleans	4	16	2.50
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3½	16	*2.18*
Detroit	4	16	....
Cincinnati	3½	16	2.38
Kansas City	4	16	3.00
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	June 5	One Year Ago	June 5	One Year Ago	June 5	One Year Ago
New York (*alongside dock*)	$1.75	$2.25	$1.75	$2.25	*$1.00*	$1.25
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	2.00	2.00	2.00	2.00	2.00	2.00
St. Louis	**1.60**†	2.40†	**1.60**†	2.45†	**1.35**†	2.10†
Seattle	1.50	1.25	1.50	1.25	1.50	1.25
Dallas	2.38	2.25	2.38	2.25	2.00	1.95
Minneapolis	1.85*	1.85*	1.85*	2.10*	*1.25*	1.25
Cincinnati	1.40†	1.50†	1.40†	1.50†	1.35†	1.50†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	**1.40**†	1.50†	**1.40**†	1.50†	**1.10**†	1.20†
New Orleans	3.00	2.85	3.00	2.85	1.25	1.25
Los Angeles	2.15	....	2.20	....	1.70	1.10†
Atlanta	2.00†	1.90†	2.00†	1.90†	1.40†	1.24†
Detroit	2.05	1.62*	1.75	1.62	1.35	2.02½
Baltimore	1.40	1.86	1.60	2.06	0.70†	0.80†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham	1.90†	....	2.05	....	**1.25**†	1.45†
Philadelphia	2.10	1.85	**2.10**	1.95	1.50	1.90
Kansas City	....	1.60	....	1.60	0.66*	0.66†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit. † Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. June 5	1½ In. One Year Ago	¾ In. June 5	¾ In. One Year Ago
New York	$1.75	$1.65	$1.85	$1.75
Chicago	2.00	2.00	2.00	2.00
St. Louis	*1.75**	2.10	*1.75**	2.35
Dallas	2.83	2.50	2.83	2.50
San Francisco	2.15	2.15	2.15	2.15
Boston	1.45*	1.75*	1.45*	1.75*
Minneapolis	*1.75*	2.00	*1.75*	2.25
Kansas City	1.50	1.50	1.50	1.50
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles *delivered*	3.00	1.60	3.10	1.60
Detroit	1.75	1.75	1.75	1.75
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	1.80*	1.90*	1.90*
Philadelphia	2.10	1.80*	2.10	1.65*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00		2.00	

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	....
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J.	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	*18.74*	*18.40*	18.75‡	18.75‡
Boston	20.00	15.00	3.90*	3.10*
Dallas	20.00	....	....	1.85†
Cincinnati	16.80	14.30	....	13.40‡
San Francisco	22.60	....	....	2.10†
Minneapolis	25.50	21.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	22.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	....	2.80†	....
Los Angeles	....	18.50	....	2.00†
Baltimore	24.25	17.85	2.55	....
Montreal	21.00	....	....	10.50‡
Atlanta	22.50	14.00	2.25†	1.65†
New Orleans	24.00	18.00	2.40†	**1.90**†
Philadelphia	23.00	16.00	1.93*	1.24†
Kansas City	18.40	18.40	3.92*	2.57*
Birmingham	14.50	**13.85**	*1.95*†	*1.75*†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	June 5	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.80	1.50
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.60	2.60
St. Louis (Carney)	**2.45**	2.85
Birmingham (Magnolia) pozzolan cement	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	June 5	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.70@2.80
New York, alongside dock to dealers	2.15	2.15	2.30
Jersey City	2.33	2.33	2.48
Boston	2.65	2.63	2.80
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.24
Cleveland	2.39	2.39	2.46
Detroit	2.40	2.40	2.48
Indianapolis	2.41	2.41	2.41
Milwaukee	2.35	2.35	2.37
Duluth	2.19	2.19	2.14
Peoria	2.37	2.37	2.41
Cedar Rapids	2.40	2.40	2.48
Davenport	2.39	2.39	2.43
St. Louis	2.30	2.30	2.35
San Francisco	2.61	2.61	2.71
New Orleans	2.40	2.40	3.30
Minneapolis	2.42	2.42	2.39
Denver	2.84	2.84	2.84
Seattle	2.90	2.90	2.90
Dallas	2.05	2.05	2.25
Atlanta	2.35	2.35	2.85
Cincinnati	**2.52**	2.47	2.54
Los Angeles	3.00	3.00	3.20
Baltimore	2.50	2.50	2.65
Birmingham	2.65	2.65	2.50
Kansas City	2.27	2.27	2.45
Montreal	2.25	2.25	2.25
Philadelphia	2.41	2.41	2.41
St. Paul	2.42	2.42	2.39
Toledo	2.45	2.45	2.48

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Bannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.15
Iola, Kan.	1.95	Alpena, Mich.	2.00
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.95	$1.02	$1.24	$1.04	$1.13	$1.21
049	28	1.20	1.30	1.58	1.32	1.38	1.52
068	35	1.47	1.59	1.94	1.62	1.67	1.87
093	45	1.89	2.04	2.50	2.08	2.00	2.42
126	57	2.34	2.53	3.09	2.59	2.55	3.07
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3.47	5.22	3.54	3.47	.....
245	103	4.22	4.57	4.60	4.66	4.58	.....
287	119	4.85	5.28	6.44	5.39	5.26	6.25
038	138	5.66	6.13	7.39	6.25	6.11	.....
095	160	6.56	7.10	8.67	7.25	7.12	.....
PAVING							
036P	17	$0.72	$0.78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1.71	1.42	1.39	.....
097P	40	1.66	1.80	2.20	1.83	1.90	.....
049R	24	.....	1.10	.....	1.12	1.07	.....
067R	31	.....	1.40	.....	1.42	1.39	.....
089R	40	.....	1.80	.....	1.83	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Weight in pounds	New York	Chicago	St. Louis	San Francisco	Dallas
2.2	$22.00	$19.00	$20.00	$19.00	$25.50
2.5	22.00	21.00	21.00	21.50	27.58
2.8	22.00	22.50	24.50	.....	30.71
3.0	24.00	24.50	26.50	23.00	33.16
3.4	27.00	26.50	29.00	.....	35.10

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger..	$2.25	$2.70	$3.49	$3.20	$3.35	$3.38	$3.65
⅝	2.30	2.85	3.59	3.25	3.45	3.43	3.75
¾	2.35	2.95	3.69	3.30	3.55	3.48	3.85
⅞	2.50	3.00	3.89	3.45	3.75	3.63	4.05
1	2.75	3.05	4.49	3.70	4.35	3.78	4.65

For size and cutting extras, manufacturers and distributers, see bar card of July 1, 1923.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2.30	$3.05	$3.08	⅝	$2.70	$3.30	$3.30
¾ in.....	2.40	3.10	3.13	1	3.30	3.50	3.48
⅞	2.50	3.15	3.18	.....	.....	.....	.....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: June 5	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	$23.65	$23.65	$23.50	$46.50	$53@54
New York (at dock)...	20.00	20.00	20.00	.....	.....
Chicago.....	11.00	11.00	11.00	34.00	42.00
St. Louis, salmon.....	16@18	16@18	16@18	40.00	*38.00*
Denver, salmon.....	12.00	12.00	12.00	.....	.....
Dallas.....	14.10	14.10	12.90	35.00	.....
San Francisco.....	15.50	15.50	15.00	.....	.....
Los Angeles.....	14.50	14.50	15.00	(not used)	
Boston (del.).....	22.50	22.00	22.50	*48.50*	*56.00*
Minneapolis (del.).....	*14.00*	15.00	17@19	.....	.....
Kansas City.....	16.50	16.50	14.50	(no market)	
Seattle.....	15.00	15.00	13.00	.....	58.50
Cincinnati.....	17.00	17.00	20.00	40.00	45.00
Montreal.....	17.50	17.50	16.50	100.00†	68.00
Detroit (del.).....	17.50	17.50	19.50	38.50	41.50
Baltimore.....	18.00	18.00	21.00	40.00	45.00
Atlanta.....	12.00	12.00	14.00	40.00	45.00
New Orleans.....	19.50	19.50	18.25	.....	.....
Birmingham.....	12.50	12.50	12.50	40.00	45.00
Philadelphia.....	*19.00*	21.00	19@25	38.00	46.00
Pittsburgh (del.).....	16.00	16.00	16.00	.....	.....
Cleveland.....	16.00	16.00	16.00	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: June 5 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.1162	$0.1573	$0.064	$0.125	$0.078	$0.108	.....
6x12x12...	.1743	.2097	.088	.....	.106	.156	.....
8x12x12...	.2179	.2621	.12	.215	.14	.244	.....
10x12x12...	.....	.....	.1511	.....	.165	.....	$0.2786
12x12x12...	.....	.....	.176	.....	.21	.....	.3448

* 5 per cent off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.125	$0.23	.....
Minneapolis (f.o.b. cars).....	.073	.12	$0.215
Minneapolis (delivered).....	.08	.13	.23
Cincinnati.....	.07485	.13745	.....
Kansas City.....	.086	.158	.....
Denver.....	.075	.123	.188
Seattle (delivered).....	.11	.25	.36
Los Angeles.....	.0931	.1686	.....
New Orleans.....	.14	.24	.2737
Detroit (delivered).....	.1044	.1958	.30
Montreal.....	.12	.225	.....
Baltimore.....	.125	.27	.....
Atlanta.....	.091	.1516	.....
Dallas.....	.11	.20	.285
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.08	.164	.....

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.....	$2.25@2.30	$3.00	$3.59	$4.40	$3.45	$3.30	$3.60
Channels, 3 to 15 in....	2.25@2.30	3.00	3.59	4.40	3.45	3.30	3.60
Angles, 3 to 16 in., ¼ in. thick.....	2.25@2.30	3.00	3.59	4.40	3.45	3.30	3.60
Tees, 3 in. and larger...	2.25@2.30	2.90	3.59	4.40	3.50	3.30	3.60
Plates, ¼ in. thick and heavier.....	2.25@2.30	3.00	3.59	4.40	3.45	3.30	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	New York: June 5	New York: One Yr. Ago	Warehouse: Chicago	St. Louis	San Francisco	Dallas
½ in.....	$2.60@2.75	$4.00	$4.40	$3.75	$3.90	$5.00	$4.90
CONE HEAD BOILER							
½ in.....	$3.00	$4.10	$4.50	$3.85	$4.10	$5.20	$5.00
⅝ and ¾.....	3.15	4.26	4.66	4.00	4.45@4.70	5.35	5.15
⅞ and 1.....	3.40	4.50	4.90	4.25	4.85	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$2.90@3.00	$3.80	$4.10	$4.55	$3.34	$4.95
Cut.....	3.00	4.45	5.25	5.75	3.59	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½.....	$8.25	$6.20	$7.75
⅝.....	7.80	5.80	5.75
¾.....	7.65	5.65	5.35

Pittsburgh base in lots of 200 kegs or more, $3.25@3.50.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.64 per roll to consumers in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $6.95 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.10 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to consumers in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$85.73
Tar pitch (in 400-lb. bbl.), per 100 lb.....	2.13
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	40.50
Asphalt felt (light), per ton, f.o.b. plant*.....	87.75
Asphalt felt (heavy), per ton, f.o.b. plant*.....	87.75

* Delivered in Metropolitan Dist., $2.00 additional.

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 86 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 85 per cent; "B," 88 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.80@3.00	$4.10	$4.00	$5.00	*$4.14*
No. 12.....	*2.90*@3.05	4.15	4.05	5.05	*4.19*
No. 14.....	*3.00*@3.15	4.20	4.10	5.10	*4.24*
No. 16.....	*3.20*@3.35	4.30	4.20	5.20	*4.34*
Black					
*Nos. 18 and 20.....	*3.50*@3.70	4.80	4.55	5.60	4.65
*Nos. 22 and 24.....	*3.55*@3.75	4.85	4.55	5.65	4.70
*No. 26.....	*3.60*@3.80	4.90	4.60	5.70	4.75
*No. 28.....	*3.65*@3.85	5.00	4.70	5.80	4.85
Galvanized					
No. 10.....	$3.85@4.00	5.00	4.60	5.50	4.90
No. 12.....	*3.95*@4.10	5.10	4.70	5.60	5.00
No. 14.....	*3.95*@4.10	5.10	4.70	5.60	5.00
Nos. 17 to 21.....	*4.25*@4.40	5.40	5.00	5.90	5.30
Nos. 22 and 24.....	*4.35*@4.50	5.55	5.15	6.05	5.45
*Nos. 25 and 26.....	*4.45*@4.60	5.70	5.30	6.20	5.55
*No. 28.....	*4.75*@5.00	6.00	5.60	6.50	5.85

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: June 5	New York: One Year Ago	Chicago: June 5	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$0.98	$1.16	$0.94	$1.37

WHITE AND RED LEAD—In 100-lb. kegs, base prices in cents per pound:

	Dry		In Oil	
	June 5	1 Yr. Ago	June 5	1 Yr. Ago
Red	15.00	14.50	16.50	16.00
White	15.00	14.50	15.00	14.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$35.00	$36.00	$37.00	$40.00
3x6 and 8	35.00	36.00	37.00	40.00
4x4-6 and 8	35.00	36.00	37.00	40.00
3x10 and 12	35.00	36.00	37.00	40.00
3x14	39.00	39.00	41.00	43.00
4x10 and 12	35.00	36.00	37.00	40.00
4x14	39.00	39.00	41.00	43.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$37.00	$39.00	$41.00
6x14	38.00	40.00	42.00
8x10	37.00	39.00	41.00
8x14	38.00	40.00	42.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$46.00	$47.00	$41.50	$43.50
3x10 to 10x10	50.00	51.00	46.50	48.50
3x12 to 12x12	54.00	55.00	51.50	53.50
3x14 to 14x14	60.00	61.00	57.50	59.50
3x16 to 16x16	67.00	68.00	67.50	69.50
3x18 to 18x18	.....	.....	77.50	79.50
4x20 to 20x20	.....	.....	86.50	88.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$57.50	$66.00†	$50.00	$50.00	$73.50	$88.00†
Seattle	.....	29.50	.....	.....	.....	25.00
New Orleans	30.00	.....	.....	.....	40.00	.....
Baltimore	32.50	49.50	53.00	60.00	38.00	49.75
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Montreal	50.00	58.00	.....	.....	.....	65.00
Los Angeles	.....	49.00	.....	.....	.....	50.00
Denver	.....	36.75	36.75	36.75	.....	37.75
Minneapolis	40.00	38.75	39.00	.....	43.10	39.75
Atlanta	36.00	.....	.....	.....	40.00	.....
Dallas	55.00	.....	.....	.....	60.22	.....
Kansas City	43.50	48.50	.....	.....	54.50	49.50
Birmingham	24@28	.....	.....	.....	28@32	.....
Philadelphia	46.00	39.00	43.50	45.00	59.00	40.00
Detroit	40.75	46.75	.....	.....	49.75	46.75
St. Louis	42.00	.....	.....	.....	54.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$47.00	$52.50†	$45.00	$56.00	$60.00†
Seattle	.....	25.00	.....	.....	29.00
New Orleans	68.00	.....	.....	34.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	75.00	80.00	75.00	38.00	88.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.....	49.00	.....	.....	.....
Denver	.....	34.25	34.25	.....	30.25
Minneapolis	45.00	35.25	35.50	37.00	32.25
Atlanta	24.00	.....	.....	34.00	.....
Dallas	55.00	.....	.....	58.66	.....
Kansas City	80.50	46.00	.....	77.50	.....
Birmingham	20@25	.....	.....	31@35	.....
Philadelphia	31.00	39.00	43.00	49.00	38.00
Detroit	38.75	35.00	.....	44.00	36.75
St. Louis	41.00	.....	.....	30.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft. additional.

*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

June 5	One Month Ago	One Year Ago
$2.35@2.40	$2.40@2.50	$2.65@2.75

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern New York and Missouri River	Territory East of
Hercules red strand, all constructions	20%	
Patent flattened strand, special steel wire rope	20%	
Patent flattened strand, iron rope	5%	
Plow steel round strand rope	35%	
Special steel round strand rope	30%	
Cast steel round strand rope	20%	
Round strand iron and iron tiller	5%	
Galvanized steel rigging and guy rope	7½%	
Galvanized iron rigging and guy rope	+12½%	

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¼-in., 8 ft., ½-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

Boston	$0.17½@.22	New Orleans	$0.17½
New York	.19½	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	.19½	St. Louis	.18½
San Francisco	.17	Montreal	.22
Atlanta	.22	Detroit	.20
Denver	.19½@20½	Baltimore	.18
Cincinnati	.21	Kansas City	.19½
Dallas	.21	Birmingham	.20
Philadelphia	.18½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.2275	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1925	.2225
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.2125	.2325
Montreal	.195	.235
Birmingham	.16	.17
New Orleans	.235	.29
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.35@1.40
Sulphate of copper, in bbl., per 100 lb.	4.65@4.80
Soda ash, 58%, in bags, per 100 lb.	1.25@1.45
Chlorine, liquid, cylinders, 100 lb., per lb. (f.o.b works)	.05½@.07½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.25@2.35

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.15*
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.15*	St. Paul	.60

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.